VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

May 25, 2016

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Director, Division of Spent Fuel Management
Office of Nuclear Material Safety and Safeguards
Washington, DC 20555-0001

Serial No. 16-031
NLOS/TJS R0
Docket No. 72-16
License No. SNM-2507

VIRGINIA ELECTRIC AND POWER COMPANY
OLD DOMINION ELECTRIC COOPERATIVE
NORTH ANNA POWER STATION INDEPENDENT SPENT FUEL STORAGE INSTALLATION (ISFSI)
LICENSE RENEWAL APPLICATION

Pursuant to 10 CFR 72.42, Virginia Electric and Power Company (Dominion Virginia Power or Dominion) on behalf of itself and Old Dominion Electric Cooperative (ODEC) submits the attached application for renewal of the North Anna Power Station site-specific ISFSI license SNM-2507. The current license expires on June 30, 2018. The application requests that this license be renewed for an additional 40 years.

The License Renewal Application (LRA) was prepared in accordance with applicable provisions of 10 CFR 72 as directed by NUREG-1927, "Standard Review Plan for Renewal of Spent Fuel Dry Cask Storage System Licenses and Certificates of Compliance," dated March 2011 (with consideration given to draft Revision 1 dated June 2015).

Approval of this license renewal application is requested by June 30, 2018. Dominion requests a 60-day implementation period after receiving the renewed license so that applicable program and procedure changes can be completed.

NMSS20
NMSS26

If you have any questions or require additional information, please contact Mr. Thomas Szymanski at (804) 273-3065.

Sincerely,

Mark D. Sartain
Vice President – Nuclear Engineering

COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Mark D. Sartain, who is Vice President – Nuclear Engineering, of Virginia Electric and Power Company. He has affirmed before me that he is duly authorized to execute and file the foregoing document in behalf of that Company, and that the statements in the document are true to the best of his knowledge and belief.

Acknowledged before me this 25th day of May, 2016.

My Commission Expires: January 31, 2020

WANDA D. CRAFT
Notary Public
Commonwealth of Virginia
Reg. # 7520495
My Commission Expires January 31, 2020

Wanda D. Craft
Notary Public

Commitments made in this letter:

After approval of this license renewal application:

1. Summary descriptions of the ISFSI aging management programs and Time-Limited Aging Analysis provided in the License Renewal Application, Appendix C will be incorporated into the NAPS ISFSI Safety Analysis Report (SAR) as part of the next periodic SAR update in accordance with 10 CFR 72.70(c).

2. The TN-32 Dry Storage Cask Aging Management Program will be implemented.

3. The Monitoring of Structures Aging Management Program will be implemented.

Attachment: Application for Renewal of ISFSI Site-Specific License SNM-2507 dated May 2016

cc: U.S. Nuclear Regulatory Commission
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North Anna Power Station

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State Health Commissioner
Virginia Department of Health
James Madison Building – 7th Floor
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Room 730
Richmond, Virginia 23219

Serial No. 16-031
Docket No. 72-16

Attachment

Application for License Renewal of ISFSI Site-Specific License SNM-2507
May 2016

North Anna Power Station ISFSI

Virginia Electric and Power Company

Old Dominion Electric Cooperative

APPLICATION FOR RENEWAL OF ISFSI SITE-SPECIFIC LICENSE SNM-2507
MAY 2016

NORTH ANNA INDEPENDENT SPENT FUEL STORAGE INSTALLATION

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NUREG-1927 Table 1-1 Relationship of Regulations and General Information Review

Areas of Review	Link to CFR section						
	72.22 (a - d)[1] Contents of application	72.22 (e)[1] Contents of application	72.30 (c)[1] Financial assurance and recordkeeping for decommissioning	72.34[1] Environmental Report	72.42 Duration of license; renewal	72.48 (d) Changes, tests, and experiments.	72.240 (b), (c), (d)[2] Conditions for spent fuel storage cask renewal
Application Content	Section 1.1				Section 1.0	Table 2.2-1 Section 2.2.2	N/A - CoC only
General Information	Section 1.3						
Financial Information		Section 1.3.5	Section 1.3.6				
Environmental Report				Appendix E			

1. These regulations apply only to specific license renewals per 10 CFR 72.13, "Applicability."

2. These regulations apply only to CoC renewals per 10 CFR 72.13.

NUREG-1927 Table 2-1 Relationship of Regulations and Scoping Review

Areas of Review	Link to CFR section							
	72.3 Definitions	72.24 (b), (c), (d)[1] Contents of application: Technical information	72.24 (g)[1] Contents of application: Technical information	72.42 (b)[1] Duration of license; renewal	Subpart F: Applicable Sections 72.120 General considerations 72.122 Overall requirements 72.124 Criteria for nuclear criticality safety[2] 72.126 Criteria for radiological protection 72.128 Criteria for spent fuel, high-level radioactive waste, and other radioactive waste storage and handling			72.236[3] Specific requirements for spent fuel storage cask approval and fabrication (Applicable Sections)
Scoping Process			Appendix C Appendix D Element 10[4]	Section 1.0 Appendix A Appendix B Appendix E				N/A - CoC only
SSCs within the Scope of Specific-License or CoC Renewal	Section 2.2.1	Section 2.3 Section 2.4 Appendix B SAR Chap 8	Appendix C SAR Materials License SNM-2507		72.120:	SAR Chap 3	SAR Appendix A	N/A - CoC only
					72.122:	SAR Table 4-1		
					72.124:	SAR Appendix A	SAR 3.3.4	
					72.126:	Section E4.2	SAR Table 4-1 SAR Chap 7 SAR Chap 8	
					72.128:	Section E4.4	SAR Table 4-1	
SSCs not within the Scope of Specific-License or CoC Renewal		Table 2.3-2 Section 2.5.1	Appendix C Appendix D		Table 2.3-2 Section 2.5.1			N/A - CoC only

1. These regulations apply only to specific license renewals per 10 CFR 72.13, "Applicability."
2. Refer to Material License SNM-2507 for exemptions.
3. These regulations apply only to CoC license renewals per 10 CFR 72.13.
4. Link is to the TN-32 Dry Storage Cask AMP. Similar information appears in the Monitoring of Structures Aging Management Program.

NUREG-1927 Table 3-1 Relationship of Regulations and Aging Management Reviews

Areas of Review	Link to CFR section																		
	72.24[1] (d) Contents of application: Technical information	72.82[1] (d) Inspections and tests	72.104[1] (a) Criteria for radioactive materials in effluents and direct radiation from an ISFSI or MRS	72.106[1] (b) Controlled area of an ISFSI or MRS	72.120[1] (a), (d) General considerations	72.122[1] (a), (b), (c), (h)(1), (h)(5), (l) Overall requirements	72.122[1] (f), (h)(4), (i) Overall requirements	72.124 Criteria for nuclear criticality safety[2]	72.126[1] Criteria for radiological protection	72.128[1] (a) Criteria for spent fuel, high-level radioactive waste, and other radioactive waste storage and handling	72.158 Control of special processes	72.162 Test control	72.164 Control of measuring and test equipment	72.168 (a) Inspection, test, and operating status	72.170 Nonconforming materials, parts, or components	72.172 Corrective action	72.236[3] Specific requirements for spent fuel storage cask approval and fabrication (Applicable Sections)	72.240[2] (d) Conditions for spent fuel storage cask renewal
Aging Effects	Sections 3.2, 3.3, 3.4		Section 2.4, E4.2	Section 2.4, E4.4	Section 3.1.2	SAR Table 4-1		Section C3.1	Section E4.2		Element 9[4]	Element 9[4]	Element 9[4]				N/A - CoC only	N/A - CoC only
Aging Management, Maintenance, or Surveillance Programs		Element 4 Element 10					Element 4		Section E4.2 SAR Table 4-1	Section E4.4	Element 9[4]	Element 9[4]	Element 9[4]	Element 7[4] Element 9[4]	Element 9[4]	Element 7[4]	N/A - CoC only	N/A - CoC only
TLAAs	Appendix B														Appendix B			

1. These regulations apply only to specific license renewals per 10 CFR 72.13, "Applicability."
2. Refer to Material License SNM-2507 for exemptions.
3. These regulations apply only to CoC renewals per 10 CFR 72.13.
4. Link is to the TN-32 Dry Storage Cask AMP. Similar information appears in the Monitoring of Structures Aging Management Program.

1.0 GENERAL INFORMATION

Virginia Electric and Power Company (Dominion Virginia Power or Dominion) and Old Dominion Electric Cooperative (ODEC) are filing this application for renewal of the Independent Spent Fuel Storage Installation (ISFSI) license for North Anna Power Station, License Number SNM-2507. The original 20-year North Anna ISFSI license will expire on June 30, 2018. This application requests renewal of the original site-specific North Anna ISFSI license for a period of 40 years, and includes the applicable general, technical, and environmental supporting information required by 10 CFR 72.42(b). This application addresses the requirements for ISFSI license renewal, which are more limited in scope than those for initial licensing.

The design basis for the ISFSI will be carried forward through the period of extended operation, except as revised by the amendment process of 10 CFR 72.56. Dominion has a pending amendment to SNM-2507 to use a modified TN-32B cask (TN-32B HBU) to store high burnup spent fuel for North Anna Units 1 and 2.

The information contained in this section includes:

1. Information on application format and content (Section 1.1).
2. A general description of the North Anna ISFSI site (Section 1.2).
3. The information required by 10 CFR 72.22 (Section 1.3).
4. Summary of acronyms (Section 1.4).
5. A distribution list for written communications related to the application (Section 1.5).

1.1 Application Format and Content

The application format and content are based on the guidance for renewal of site-specific Part 72 licenses described in the Standard Review Plan for Renewal of Spent Fuel Dry Cask Storage System Licenses and Certificates of Compliance (Reference 4.1) and has taken into consideration its proposed revision. The application includes:

1. General Information - Section 1.0 has been expanded beyond the requirements of 10 CFR 72.22 to provide (1) information on the format and content of the application; (2) a general facility description; (3) a summary of acronyms used in the application; and (4) a distribution list for written communications related to the application.
2. Scoping Evaluation - Section 2.0 provides the scoping evaluation for the North Anna ISFSI components.
3. Aging Management Reviews - Section 3.0 includes the methodology used to perform aging management reviews (AMRs).

4. Appendices -

   Appendix A: Aging Management Programs

   Appendix B: Time-Limited Aging Analyses (TLAAs)

   Appendix C: ISFSI Safety Analysis Report (SAR) Supplement

   Appendix D: Technical Specification Changes

   Appendix E: Environmental Report Supplement

   Appendix F: Additional Information (training and qualifications, pre-application inspections)

   Appendix G: Non-Quantifiable Terms

   Appendix H: ISFSI Decommissioning Funding Plan

1.2 Facility Description

The North Anna ISFSI is located on the North Anna Power Station site on the southern shore of Lake Anna in Louisa County, in north-central Virginia. The 11-acre ISFSI is located near the edge of the 1,803 acre plant site, approximately 2,000 feet southwest of Units 1 and 2 of the North Anna Power Station.

The North Anna ISFSI consists of reinforced concrete storage pads on which loaded dry spent fuel storage casks are placed. There are currently two licensed storage pads in place at the North Anna ISFSI. This renewal application is limited to seeking renewal of the site-specific license (License Number SNM-2507) which includes the reinforced concrete pad designated as pad No.1. The second reinforced concrete pad at the North Anna ISFSI is licensed pursuant to the general license provisions contained in NRC regulations in 10 CFR 72.210 and is not part of this renewal application. A complete description of the North Anna ISFSI site is provided in the North Anna ISFSI Safety Analysis Report.

The North Anna Power Station Unit 1 and 2 reactors are operated under separate licenses issued pursuant to the provisions of 10 CFR Part 50 and therefore are not addressed in this application.

1.3 Information Required by 10 CFR 72.22

1.3.1 Name of Applicants

- Virginia Electric and Power Company (Dominion Virginia Power or Dominion), 88.4% ownership
- Old Dominion Electric Cooperative (ODEC),11.6% ownership

1.3.2 Address of Applicants

Virginia Electric and Power Company	Old Dominion Electric Cooperative
5000 Dominion Boulevard	4201 Dominion Boulevard
Glen Allen, VA 23060	Glen Allen, VA 23060

1.3.3 Description of Business or Occupation of Applicants

Dominion Virginia Power incorporated in Virginia in 1909 as a Virginia public service corporation, is a wholly-owned subsidiary of Dominion Resources, Inc., and a regulated public utility that generates, transmits and distributes electricity for sale in Virginia and North Carolina. In Virginia, the company conducts business under the name "Dominion Virginia Power" and primarily serves retail customers. In North Carolina, it conducts business under the name "Dominion North Carolina Power" and serves retail customers located in the northeastern region of the state, excluding certain municipalities. In addition, Dominion Virginia Power sells electricity at wholesale prices to rural electric cooperatives, municipalities and into wholesale electricity markets. All of Dominion Virginia Power's stock is owned by Dominion Resources, Inc.

ODEC, which was incorporated under the laws of the Commonwealth of Virginia in 1948, is a not-for-profit wholesale power supply cooperative engaged in the business of providing wholesale electric service to member distribution cooperatives, which in turn are engaged in the retail sale of power to more than 565,000 retail electric customers located in 70 counties throughout Virginia, Delaware, and Maryland.

1.3.4 Organization and Management of Applicants

Dominion Virginia Power is submitting this application on its own behalf and on behalf of ODEC. Otherwise, neither Dominion nor ODEC is acting as agent or representative of any other person in filing this application.

Dominion Virginia Power is not owned, controlled or dominated by an alien, a foreign corporation, or a foreign government. All officers and directors are citizens of the United States of America. The names and business addresses of Dominion Virginia Power's directors and principal officers are provided below:

Name	Business Address
Thomas F. Farrell, II Chairman, Chief Executive Officer	120 Tredegar Street Richmond, VA 23261
Mark F. McGettrick Director, Executive Vice President and Chief Financial Officer	120 Tredegar Street Richmond, VA 23219

Name	Business Address
Mark O. Webb Director, Senior Vice President, General Counsel and Chief Risk Officer	120 Tredegar Street Richmond, VA 23219
David A. Christian President and Chief Operating Officer	120 Tredegar Street Richmond, VA 23219
Paul D. Koonce President and Chief Operating Officer	120 Tredegar Street Richmond, VA 23219
Carter M. Reid Senior Vice President, Chief Administrative & Compliance Officer and Corporate Secretary	120 Tredegar Street Richmond, VA 23219
Robert M. Blue President	120 Tredegar Street Richmond, VA 23219
James R. Chapman Senior Vice President–Mergers & Acquisitions and Treasurer	120 Tredegar Street Richmond, VA 23219
David A. Heacock President and Chief Nuclear Officer	Innsbrook Technical Center 5000 Dominion Boulevard Glen Allen, VA 23060-6711
Edward H. Baine Senior Vice President–Distribution	120 Tredegar Street Richmond, VA 23219
P. Rodney Blevins Senior Vice President and Chief Information Officer	120 Tredegar Street Richmond, VA 23219
Katheryn B. Curtis Senior Vice President–Power Generation	Innsbrook Technical Center 5000 Dominion Boulevard Glen Allen, VA 23060-6711
Mary C. Doswell Senior Vice President–Dominion Energy Solutions	120 Tredegar Street Richmond, VA 23219

Name	**Business Address**
Daniel G. Stoddard Senior Vice President–Nuclear Operations	Innsbrook Technical Center 5000 Dominion Boulevard Glen Allen, VA 23060-6711
Thomas P. Wohlfarth Senior Vice President–Regulatory Affairs	120 Tredegar Street Richmond, VA 23219
Fred G. Wood, III Senior Vice President–Financial Management	120 Tredegar Street Richmond, VA 23219
Michele L. Cardiff Vice President, Controller and Chief Accounting Officer	701 E. Cary Street Richmond, VA 23219
David Craymer Vice President–Power Generation System Operations	Innsbrook Technical Center 5000 Dominion Boulevard Glen Allen, VA 23060-6711
J. Kevin Curtis Vice President–Technical Solutions	120 Tredegar Street Richmond, VA 23219
James E. Eck Vice President–Business Development	120 Tredegar Street Richmond, VA 23219
Pamela F. Faggert Chief Environmental Officer and Senior Vice President–Sustainability	Innsbrook Technical Center 5000 Dominion Boulevard Glen Allen, VA 23060-6711
Arnold J. Jordan, Jr. Vice President–Shared Services	120 Tredegar Street Richmond, VA 23219
Becky C. Merritt Vice President–Customer Service	120 Tredegar Street Richmond, VA 23219

Name	Business Address
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Corynne Arnett Vice President–Financial Management	120 Tredegar Street Richmond, VA 23219
Kenneth D. Barker Vice President–Community Partnerships	120 Tredegar Street Richmond, VA 23219
Mark D. Mitchell Vice President–Generation Construction	Innsbrook Technical Center 5000 Dominion Boulevard Glen Allen, VA 23060-6711
Alma W. Showalter Vice President–Tax	701 E. Cary Street Richmond, VA 23219
Mark D. Sartain Vice President–Nuclear Engineering	Innsbrook Technical Center 5000 Dominion Boulevard Glen Allen, VA 23060
Gerald T. Bischof Site Vice President–North Anna	North Anna Power Station 1022 Haley Drive Mineral, VA 23117
N. Larry Lane Site Vice President–Surry	Surry Power Station 5570 Hog Island Road Surry, VA 23883

ODEC is not owned, controlled or dominated by an alien, a foreign corporation, or a foreign government. All officers and directors of ODEC are citizens of the United States of America. ODEC is governed by a board of directors, consisting of representatives from each of its member distribution cooperatives and one representative from TEC Trading, Inc.

The names and business addresses of ODEC's directors are provided below:

Name	**Business Address**
Myron D. Rummel Chairman of the Board, President & CEO, Shenandoah Valley Electric Cooperative	4201 Dominion Boulevard Glen Allen, Virginia 23060
J. William Andrew, Jr. Vice-Chairman of the Board, President & CEO, Delaware Electric Cooperative	4201 Dominion Boulevard Glen Allen, Virginia 23060
Kent D. Farmer Secretary/Treasurer of the Board, President & CEO, Rappahannock Electric Cooperative	4201 Dominion Boulevard Glen Allen, Virginia 23060
E. Garrison Drummond A&N Electric Cooperative	4201 Dominion Boulevard Glen Allen, Virginia 23060
Michael J. Keyser CEO & General Manager, BARC Electric Cooperative	4201 Dominion Boulevard Glen Allen, Virginia 23060
Keith L. Swisher BARC Electric Cooperative	4201 Dominion Boulevard Glen Allen, Virginia 23060
Michael I. Wheatley President & CEO, Choptank Electric Cooperative	4201 Dominion Boulevard Glen Allen, Virginia 23060
Carl R. Widdowson Choptank Electric Cooperative	4201 Dominion Boulevard Glen Allen, Virginia 23060
Steven A. Harmon President & CEO, Community Electric Cooperative	4201 Dominion Boulevard Glen Allen, Virginia 23060

Name	Business Address
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Bruce A. Henry Delaware Electric Cooperative	4201 Dominion Boulevard Glen Allen, Virginia 23060
David J. Jones Mecklenburg Electric Cooperative	4201 Dominion Boulevard Glen Allen, Virginia 23060
John C. Lee, Jr. President & CEO, Mecklenburg Electric Cooperative	4201 Dominion Boulevard Glen Allen, Virginia 23060
Hunter R. Greenlaw, Jr. Northern Neck Electric Cooperative	4201 Dominion Boulevard Glen Allen, Virginia 23060
Gregory W. White President & CEO, Northern Neck Electric Cooperative	4201 Dominion Boulevard Glen Allen, Virginia 23060
Micheal E. Malandro President & CEO, Prince George Electric Cooperative	4201 Dominion Boulevard Glen Allen, Virginia 23060
Paul H. Brown Prince George Electric Cooperative	4201 Dominion Boulevard Glen Allen, Virginia 23060
Darlene H. Carpenter Rappahannock Electric Cooperative	4201 Dominion Boulevard Glen Allen, Virginia 23060
Fred C. Garber Shenandoah Valley Electric Cooperative	4201 Dominion Boulevard Glen Allen, Virginia 23060
Earl C. Currin, Jr. Southside Electric Cooperative	4201 Dominion Boulevard Glen Allen, Virginia 23060
Jeffery S. Edwards President & CEO, Southside Electric Cooperative	4201 Dominion Boulevard Glen Allen, Virginia 23060

The names and business addresses of ODEC's principal officers are listed below:

Name	Business Address
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Robert Kees Senior Vice President & Chief Financial Officer	4201 Dominion Boulevard Glen Allen, Virginia 23060
D. Richard Beam Senior Vice President of Power Supply	4201 Dominion Boulevard Glen Allen, Virginia 23060
Elissa Ecker Vice President of Human Resources	4201 Dominion Boulevard Glen Allen, Virginia 23060

1.3.5 Financial Qualifications

As required by 10 CFR 72.22(e), Dominion Virginia Power and ODEC will remain financially qualified to carry out the activities associated with spent fuel storage at the North Anna ISFSI throughout the period of the renewed license. As regulated electric utilities, Dominion Virginia Power and ODEC have the ability to recover their costs of service, including construction and operating costs, through rates.

The estimated construction costs for the North Anna site-specific license ISFSI have been updated as part of this license renewal application. The North Anna ISFSI Safety Analysis Report indicates that up to three concrete storage pads could be used under the specific license. While there are no current plans to expand the pad capacity under the specific license beyond reinforced concrete pad No. 1, Dominion Virginia Power and ODEC retain the authority to do so under the terms of the North Anna ISFSI license. One-time construction costs for the remaining unconstructed portion of the ISFSI are estimated at $17M in 2016 dollars.

The estimated operating costs for the North Anna specific license ISFSI have been updated as part of this license renewal application. Estimated operating costs over the period of the renewed license for the North Anna specific license ISFSI are conservatively assumed to be $400M in 2016 dollars, or approximately $10M per year. This amount includes costs associated with ISFSI security, project management, cask maintenance, and equipment surveillances. While there are no current plans to expand the pad capacity under the specific license beyond reinforced concrete pad No. 1, Dominion and ODEC retain the

authority to do so under the terms of the North Anna ISFSI license. Accordingly, the estimated operating costs also include hypothetical costs associated with purchasing and loading additional casks up to the full licensed capacity. The costs included within the estimated operating costs relate to the specific license, except for the security costs, which are shared with the generally licensed ISFSI.

As demonstrated in the Securities and Exchange Commission filings linked below, Dominion Virginia Power's and ODEC's annual operating revenues (over $7.6 billion and $1.0 billion, respectively, for the year ended December 31, 2015) are orders of magnitude greater than the estimated costs for the North Anna specific license ISFSI. This information provides reasonable assurance of Virginia Power's and ODEC's abilities to obtain the necessary funds to cover estimated construction and operating costs over the planned life of the NAPS specific license ISFSI. The Dominion 10-K Annual Filing for 2015 (which includes Dominion Virginia Power) may be found on-line at:

https://www.sec.gov/Archives/edgar/data/103682/000119312516480850/d126742d10k.htm

The ODEC 10-K Annual Filing for 2015 may be found on-line at:

https://www.sec.gov/Archives/edgar/data/885568/000088556816000013/a201510-k.htm

1.3.6 Financial Assurance for Decommissioning

Dominion Virginia Power and ODEC provide financial assurance for the decommissioning of the North Anna Power Station, including the North Anna ISFSI, using the external sinking fund method. The collections are based on site-specific cost estimates prepared by Dominion that include radiological decommissioning, spent fuel management (including ISFSI decommissioning), and site restoration. As regulated electric utilities, Dominion Virginia Power and ODEC have the ability to recover their costs of service, including decommissioning funding, through rates.

Dominion Virginia Power maintains a site Decommissioning Cost Estimate (DCE) for the North Anna Power Station which it updates approximately every five years to determine whether there is any need to adjust rates collected from ratepayers and contributed to the external sinking fund. Dominion, as an operator of the ISFSI, also prepared a DCE for the North Anna ISFSI (for both the site-specific and generally licensed pads) in 2014. Dominion plans to update the North Anna ISFSI DCE approximately every five years.

Dominion Virginia Power submitted its most recent decommissioning funding plan update for the North Anna ISFSI to the NRC on December 2, 2015 (Reference 4.3). ODEC's most recent decommissioning funding plan update for the North Anna ISFSI was submitted on December 15, 2015 (Reference 4.4).

Additionally, pursuant to 10 CFR 72.30 (c), estimated decommissioning costs for the North Anna ISFSI (both the site-specific and generally-licensed pads) have been updated by Dominion and ODEC as part of this license renewal application and are contained in Appendix H to this license renewal application. These estimated costs for North Anna ISFSI decommissioning: (1) reflect the cost of an independent contractor to perform all ISFSI decommissioning activities; (2) include an adequate contingency factor; and (3) are based on remediating the ISFSI site for unrestricted use.

This information provided in the updated North Anna ISFSI decommissioning funding plans provides reasonable assurance that funds for decommissioning the North Anna ISFSI will be available when needed.

1.4 Acronyms

This section contains the acronyms that pertain to the administrative and technical information within this application, Appendix A through Appendix D, and Appendix F. The acronyms that pertain to the environmental information are included in the front of Appendix E, Environmental Report Supplement.

Acronym	Definition
AMR	Aging Management Review
AMP	Aging Management Program
CR	Condition Report
GWD	Gigawatt-Days
ICES	INPO Consolidated Event System
ISFSI	Independent Spent Fuel Storage Installation
LRA	License Renewal Application
MTU	Metric Ton Uranium
NAPS	North Anna Power Station
NDE	Non-Destructive Examination
SAR	Safety Analysis Report
SER	Safety Evaluation Report
SSCs	Systems, Structures, and Components
SSSC	Sealed Surface Storage Cask
TLAA	Time-Limited Aging Analysis
TLD	Thermoluminescent Dosimeter
TSAR	Topical Safety Analysis Report

1.5 Communications

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2.0 SCOPING EVALUATION

2.1 Introduction

License renewal evaluations fall into two distinct processes:

- Scoping - Scoping identifies the ISFSI systems, structures, and components (SSCs) that are in the scope of license renewal and, hence, should be evaluated for the effects of aging.
- Aging management reviews (AMRs) - The AMR process assesses the effects of aging on those in-scope SSCs and assures that the effects of aging are adequately managed throughout the period of extended operation.

This section describes the scoping process for identifying the SSCs that are within the scope of license renewal and the basis for inclusion in the scope of license renewal. The SSCs excluded from the scope of license renewal are also determined during the scoping process. The scoping results provide the basis for the aging management reviews presented in Section 3.0 of this application.

The scoping process followed for this application is consistent with the Standard Review Plan for Renewal of Spent Fuel Dry Cask Storage System Licenses and Certificates of Compliance (Reference 4.1). A description of the scoping process is provided in Section 2.2, Scoping Methodology.

A listing defining the acronyms used in this section is provided in Section 1.4.

2.2 Scoping Methodology

Scoping was performed by evaluating the SSCs that comprise the ISFSI (References 4.5 and 4.6) against the scoping categories provided in Section 2.4.2 of the Standard Review Plan for Renewal of Spent Fuel Dry Cask Storage System Licenses and Certificates of Compliance (CoC) (Reference 4.1):

> The SSCs within the scope of renewal fall into the following scoping categories:
>
> 1. *They are classified as important to safety, as they are relied on to do one of the following functions:*
>   - *i. Maintain the conditions required by the regulations, specific license, or CoC to store spent fuel safely;*
>   - *ii. Prevent damage to the spent fuel during handling and storage; or*
>   - *iii. Provide reasonable assurance that spent fuel can be received, handled, packaged, stored, and retrieved without undue risk to the health and safety of the public.*

These SSCs ensure that important safety functions are met for (1) confinement, (2) radiation shielding, (3) sub-criticality control, (4) heat-removal capability, (5) structural integrity, and (6) retrievability.

2. *They are classified as not important to safety but, according to the licensing basis, their failure could prevent fulfillment of a function that is important to safety, or their failure as support SSCs could prevent fulfillment of a function that is important to safety.*

The first activity in the North Anna ISFSI scoping process is to identify all SSCs comprising the ISFSI. The ISFSI SAR is the primary source for this information, although additional sources of information listed in Section 2.2.2 are also utilized to complete the scoping evaluation. SSCs designated as important to safety (Scoping Category 1) are considered to be in the scope of license renewal.

The functions of the remaining SSCs are reviewed in the context of the design basis to determine if any SSCs perform functions that could meet Scoping Category 2. Any SSCs performing one or more functions meeting Scoping Category 2 are also in the scope of license renewal.

The function performed by an SSC that causes it to be in the scope of license renewal is its intended function. The subcomponents of the SSCs determined to be in the scope of license renewal are further reviewed to identify the subcomponent intended functions, e.g., radiation shielding, that support those SSCs important to safety, or whose failure could prevent fulfillment of a function that is important to safety.

2.2.1 Intended Function Code Definitions

This section contains the definitions for the SSC intended functions represented by the acronyms used in Table AMR Results-1 through Table AMR Results-3 beginning on Page 3-16.

Acronym	Definition
CC	Provides criticality control of spent fuel
HT	Provides heat transfer
PB	Directly or indirectly maintains the cask pressure boundary (confinement)
RS	Provides radiation shielding
RT	Supports retrieval of nuclear fuel from the storage cask
SS	Provides structural support (structural integrity)

The scoping results are presented in Section 2.3.

2.2.2 Documentation Sources Used for Scoping Process

Dominion's basis for the license renewal scoping process is that the design basis determines which SSCs perform intended functions that meet either Scoping Category 1 or 2, as defined in Section 2.2 above. The documents identified below comprise the North Anna Independent Spent Fuel Storage Installation's design basis, including those documents specifically incorporated by reference. Docketed licensing correspondence is also included as part of the design basis.

- North Anna ISFSI Safety Analysis Report (Reference 4.6)
- Materials License No. SNM-2507 (Reference 4.11)
- North Anna ISFSI Technical Specifications (Reference 4.7)
- North Anna ISFSI Safety Evaluation Report (Reference 4.8)
- TN-32 Dry Storage Cask Topical Safety Analysis Report (Reference 4.5)
- TN-32 Dry Storage Cask Topical Safety Analysis Report Safety Evaluation Report (Reference 4.9)

The ISFSI Safety Analysis Report (SAR) (Reference 4.6), as modified by 10 CFR 72.48 evaluations listed in Table 2.2-1, identifies the ISFSI SSCs, their safety classifications as established by the safety analyses, and their functions. According to the ISFSI SAR, only the TN-32 dry storage cask, the cask lift beam, and cask lid handling tools are important to safety (ISFSI SAR, Section 4.5). The cask lift beam and cask lid handling tools are included in the Heavy Loads Program, which is an aging management program credited for 10 CFR Part 54 license renewal. The cask lift beam and cask lid handling tools are therefore excluded from 10 CFR Part 72 license renewal (Refer to Table 2.3-2). Although the ISFSI SAR states that the reinforced concrete pad is not safety-related (ISFSI SAR, Section 4.5), the pad does provide structural support (Refer to Table 2.3-2). Updates to the SAR and associated 10 CFR Part 72.48 evaluations were also reviewed during the scoping process. Table 2.2-1 contains a list of the evaluations completed for the North Anna ISFSI SAR. This table does not include 10 CFR 72.48 applicability and screening reviews.

The North Anna ISFSI license (Reference 4.11) sets forth the licensing conditions under which the North Anna ISFSI facility will be operated. The license identifies fuel movement, cask movement, and handling activities occurring in the Fuel and Decontamination Buildings as being governed under the facility operating licenses for North Anna Power Station Units 1 and 2 (NPF-4 and NPF-7) and associated Technical Specifications, i.e., 10 CFR Part 50.

The materials license also identifies the following three exemptions:

- 10 CFR 72.124(b) - provide positive means to verify the continued efficacy of solid neutron absorbing materials
- 10 CFR 72.44(d)(3) - submittal date of annual effluent radionuclide release report
- 10 CFR 72.72(d) - duplicate storage of spent fuel storage records

The North Anna ISFSI Technical Specifications (Reference 4.7) govern the safety of the receipt, possession, and storage of spent fuel assemblies at the ISFSI, and the transfer of such spent fuel assemblies to and from the Fuel Building and the ISFSI.

The North Anna Independent Spent Fuel Storage Installation Safety Evaluation Report (SER) (Reference 4.8) summarizes the results of the NRC staff's safety review of the facility. The SER also identifies the TN-32 dry storage cask, lift beam, and lid handling tools as important to safety. As stated above, the lift beam and lid handling tools are used during fuel handling operations in the station Fuel and Decontamination Buildings. They are, therefore, governed by 10 CFR Part 50 and are excluded from 10 CFR Part 72 license renewal (Refer to Table 2.3-2, Scoping Results).

The TN-32 Dry Storage Cask Topical Safety Analysis Report (Reference 4.5) and associated Safety Evaluation Report (Reference 4.9) are included as part of the ISFSI design basis by reference.

2.3 Scoping Results

The SSCs comprising the ISFSI are identified in Table 2.3-2, Scoping Results. Those SSCs in Scoping Category 1 or Category 2 are identified in the table as being in the scope of license renewal.

As indicated in Table 2.3-2, only the TN-32 dry storage cask, spent fuel assemblies stored in the TN-32 dry storage casks, and reinforced concrete pad No. 1 have been determined to be in the scope of license renewal and require further review in the aging management review process. The remaining ISFSI SSCs, i.e., transporters, lift beam, cask pressure instrumentation, power supplies, lighting, backup diesel generator, fence, etc., do not meet the ISFSI license renewal scoping criteria; therefore, they are not in the scope of license renewal. The intended functions performed by the individual subcomponents of the TN-32 dry storage cask, spent fuel assemblies, and reinforced concrete pad No. 1 are identified in the aging management review results summary tables (Table AMR Results-1, Table AMR Results-2, and Table AMR Results-3).

The Transnuclear TN-32 dry storage cask is used on reinforced concrete pad No. 1 at the North Anna ISFSI. References 4.5 and 4.6 provides a description of the Transnuclear TN-32 dry storage cask. Additional details on the spent fuel stored in the TN-32 dry storage casks are provided in Section 3.1.1 and Table 3-1 of the North Anna ISFSI SAR.

Additional details on reinforced concrete pad No. 1 are provided in Section 4.2.1 of the North Anna ISFSI SAR.

The aging management review results for the ISFSI TN-32 dry storage casks, spent fuel assemblies, and reinforced concrete pad are provided in:

- Section 3.2, Aging Management Review Results - Dry Storage Cask
- Section 3.3, Aging Management Review Results - Spent Fuel Assemblies
- Section 3.4, Aging Management Review Results - Reinforced Concrete Pad No. 1

2.4 Component Descriptions

There are 27 TN-32 dry storage casks at the North Anna ISFSI. Each TN-32 dry storage cask is a right circular cylinder capable of housing up to 32 spent fuel assemblies. An internal fuel basket provides alignment and separation of the spent fuel assemblies. Helium gas is used inside the TN-32 dry storage casks to provide an inert atmosphere. A lid and seals provide an effective boundary between the internal cask environment and the outside environment. An overpressure system, consisting of pressure sensors, overpressure tank, and alarms warn of leakage past the TN-32 dry storage cask lid seals. Shielding is provided to ensure acceptable radiation levels are maintained.

Once loaded with spent fuel, a transporter moves the casks to the North Anna ISFSI where the TN-32 dry storage casks are placed on reinforced concrete pad No. 1 for long-term storage. All TN-32 dry storage casks are located on reinforced concrete pad No. 1. The North Anna ISFSI is also provided with lighting and a backup diesel generator. A monitored security fence surrounds the ISFSI.

The fuel assembly types currently stored in the TN-32 dry storage casks at North Anna include the 17 x 17 Standard and the 17 x 17 Vantage 5H design. None of the spent fuel assemblies stored in the TN-32 dry storage casks utilize top nozzle anchors or instrument tube tie rods.

A fundamental design criterion in dry storage cask construction is limiting radiation exposure to the public. 10 CFR 72.104(a) and 10 CFR 72.106(b) place limits on off-site doses during normal, off-normal, and accident conditions. A confinement dose analysis for the TN-32 dry storage casks is presented in Section 7.5 and Section 8.2.10 of the ISFSI SAR (Reference 4.6). The analysis results predict the maximum exposure to the nearest permanent resident from the combined operation of the ISFSI and NAPS to be 5.1 mrem/year, which is well below the limits of 10 CFR 72.104(a). For accident conditions the analysis predicts a deep dose plus committed dose equivalent to the bone marrow of 13 mrem at the nearest site boundary. This value is well below the limits of 10 CFR 72.106(b).

2.4.1 Detailed Description of Transnuclear TN-32 Dry Storage Cask Subcomponents

The following major subcomponents of the Transnuclear TN-32 dry storage cask are described in this section.

- Cask Body (and associated subcomponents)
- Fuel Basket
- Cask Lid
- Cask Seals

The intended functions of the cask SSCs are shown in Table AMR Results-1. Refer to References 4.5 and 4.6 for additional information.

<u>Cask Body (and associated subcomponents)</u>

The TN-32 containment vessel is comprised of a cask shell, which is a welded carbon steel cylinder with an integrally-welded carbon steel bottom; a welded flange forging (with shims and stainless steel weld overlay); a flanged and bolted low-alloy steel lid; and vent and drain port covers, cover seals and cover bolts. The cask shell and cask bottom are lined with a low-alloy steel inner and bottom containment. Radial neutron shielding is provided by borated polyester resin enclosed in aluminum, which surrounds the cask wall. A relief valve at the top of the radial neutron shield provides a vent path for the buildup of gases.

Additional neutron shielding is provided by a top neutron shield, which consists of a disc of polypropylene encased in carbon steel, that is bolted to the cask lid. A hole in the top of the neutron shield provides a vent path for the buildup of gases. The outer shell of the cask is carbon steel.

The inner and bottom containment surfaces have a sprayed metallic coating of aluminum for corrosion protection. The cask external surfaces are painted for corrosion protection and ease of decontamination. The cask sealing surfaces are clad with stainless steel for corrosion protection.

Carbon steel trunnions are provided at the cask upper and lower ends to permit cask movement and transport. A protective cover fits over the top of the cask to provide weather protection. The cover is sealed with an elastomer O-ring.

<u>Fuel Basket</u>

The fuel basket structure is made of an assembly of stainless steel cells joined by a fusion welding process and separated by aluminum and borated aluminum plates, which form a sandwich panel. Stainless bolts, washers and spacers are used to secure the fuel basket in place. The fuel basket structure is designed to hold 32 fuel assemblies.

Cask Lid

The cask lid is fabricated of low-alloy steel and secured to the cask body with bolts. A carbon steel shield plate is attached to the bottom of the lid to provide additional radiation shielding. The cask lid sealing arrangement consists of double metallic O-ring seals. The cask lid and cask flange sealing surfaces are clad with a stainless steel weld overlay to minimize corrosion. Two penetrations are provided in the cask lid for cask venting and draining evolutions. One additional penetration is provided for the overpressure system.

Cask Seals

The cask lid is equipped with Helicoflex double metallic O-ring seals. The metal seals consist of a nickel-based alloy spring with an outer seal jacket of either aluminum or silver. The cask lid and flange are provided with a stainless steel weld overlay for improved corrosion protection.

There are three access ports in the cask lid: 1) Cavity Drain Port; 2) Cavity Vent Port; and 3) Overpressure Port. For ease of operation, the cavity drain and cavity vent ports are each equipped with a quick-disconnect valve. The valves, however, are not part of the cask containment boundary.

Each of the three access ports is provided with a bolted stainless steel cover, which is equipped with Helicoflex metallic O-ring seals, constructed of the same materials as the cask lid O-rings. The vent and drain port covers have two O-rings, while the overpressure port cover has one O-ring.

An overpressure tank, equipped with a fill valve and redundant pressure sensors (switches), maintains pressure between the seals. The overpressure tank is mounted on top of the neutron shield under the protective cover. The overpressure system is designed to maintain helium pressure between the cask lid seals and cask lid penetration seals at a pressure greater than the pressure in the cask and greater than atmospheric pressure. This ensures that a seal failure will not result in leakage from the cask to the outside atmosphere.

Identification of Aging Management Review Results

The materials, environments, aging effects requiring management, and the resulting aging management activities for the TN-32 dry storage cask are provided in the following sections:

- Section 3.2.1, Materials Evaluated
- Section 3.2.2, Environments
- Section 3.2.3, Aging Effects Requiring Management
- Section 3.2.4, Aging Management Program

The results of the aging management review for the TN-32 dry storage cask are provided in Table AMR Results-1, Transnuclear TN-32 Dry Storage Cask.

2.4.2 Detailed Description of Fuel Subcomponents

Each TN-32 dry storage cask is designed to hold 32 spent fuel assemblies of the 17 x 17 Standard or 17 x 17 Vantage 5H design. Burnable poison rods and thimble plugging devices are also permitted to be stored with the spent fuel assemblies. The North Anna ISFSI Technical Specifications limits the burnup of the stored spent fuel assemblies to ≤ 45,000 MWD/MTU and decay heat to < 1.02 kW per assembly (Reference 4.7).

The following fuel assembly subcomponents are described in this section (Reference 4.10, Section 4.2):

- Fuel Cladding (including End Plugs)
- Guide Tubes
- Grid Assembly
- Bottom Nozzle
- Top Nozzle

<u>Fuel Cladding (including End Plugs)</u>

The fuel cladding is a zirconium-based alloy tube that maintains ceramic UO_2 fuel pellets in the desired configuration. The fuel cladding along with the grid assemblies intended functions are to provide structural support sufficient to allow retrievability of the fuel from the dry storage casks, maintain the fuel pellets in a coolable geometry, provide criticality control, and provide a pressure boundary to prevent the release of fission products to the cask interior.

Unlike conventional material cladding, fuel cladding is not mechanically bonded to the material that it is protecting, i.e., fuel pellets. At temperatures expected within the dry storage casks, the fuel pellets are expected to be loose within the fuel cladding.

<u>Guide Tubes</u>

The guide tubes are attached to the grid assemblies, the top nozzle and the bottom nozzle using sleeves and threaded fasteners. The guide tubes provide a means to align insert components within the fuel assembly. Insert components include rod cluster control assemblies, burnable poison rod assemblies, thimble plugging devices, and neutron sources. Only burnable poison rod assemblies and thimble plugging devices are currently licensed for storage with fuel assemblies while they are within the dry storage casks. The guide tube's intended function is to provide structural support sufficient to allow retrievability of the fuel from the dry storage casks. This is accomplished by providing a means to tie the nozzles and the grid assemblies together into the fuel assembly structure. The guide tubes are made of zirconium-based alloy. Guide tube sleeves that connect the guide tubes to the top nozzle are made of stainless steel. The guide tube threaded fasteners that connect the guide tubes to the bottom nozzle are made of stainless steel. None of the assemblies stored in the TN-32 dry storage cask utilize instrument tube tie rods.

Grid Assembly

The grid assemblies are attached to the guide tubes and provide support for the fuel cladding and position them in a square array. The grid assembly intended functions are to provide structural support sufficient to allow retrievability of the fuel from the dry storage casks, to maintain the fuel cladding in a coolable geometry, and to provide criticality control. The grid assemblies in the mid-fuel assembly region i.e., any grid assemblies except for the top and bottom assemblies, are made of nickel-based alloy or zirconium-based alloy. The top grid assembly and the bottom grid assembly are made of nickel-based alloy.

Bottom Nozzle

The bottom nozzle is connected to the guide tubes and provides a base to support the fuel assembly and provides filtering of the coolant entering the assembly. The bottom nozzle's intended function is to provide structural support sufficient to allow for fuel retrievability. The bottom nozzle is made of stainless steel.

Top Nozzle

The top nozzle is constructed of stainless steel and provides a means to lift the entire fuel assembly and is connected to the guide tubes. The top nozzle's intended function is to provide structural support sufficient to allow for fuel retrievability. None of the assemblies stored in the TN-32 dry storage cask utilize top nozzle anchors.

Identification of Aging Management Review Results

The materials, environments, aging effects requiring management, and the resulting aging management activities for the fuel assemblies are provided in the following sections:

- Section 3.3.1, Materials Evaluated
- Section 3.3.2, Environments
- Section 3.3.3, Aging Effects Requiring Management
- Section 3.3.4, Aging Management Program

The results of the aging management review for the fuel assemblies are provided in Table AMR Results-2, Spent Fuel Assemblies.

2.4.3 Detailed Description of Reinforced Concrete Pad No. 1 Subcomponents

The ISFSI is located within the North Anna Power Station site boundary. The primary purpose of the non-safety-related reinforced concrete pad No. 1 is to provide a uniform surface for storing the safety-related TN-32 dry storage casks. The final design of reinforced concrete pad No. 1 has been verified to be robust enough to withstand the maximum loads associated with all cask load conditions, yet "soft" enough to limit the deceleration of the cask during design accident cases. The intended function of reinforced concrete pad No. 1 is to provide structural support.

Reinforced concrete pad No. 1 is a reinforced concrete slab on grade with dimensions of 32 feet by 224 feet by 2 feet thick. A forty-foot long concrete access ramp is provided on each end to allow for the cask transporter to gain access to pad No. 1. The overall length of reinforced concrete pad No. 1 is 304 feet. Compacted structural fill (18 inches) is installed beneath it and is brought up to grade. The concrete has a minimum design compressive strength of 3,000 psi and is reinforced with No. 10 bars at 12 inches-on-center, each way both top and bottom of the slab. The minimum yield strength of the reinforcing steel is 60 ksi. The top surface of reinforced concrete pad No. 1 is constructed with a slope of 1/8 inch per foot in the transverse direction to provide drainage. Control joints are provided to prevent cracking of the concrete due to thermal expansion.

Identification of Aging Management Review Results

The materials, environments, aging effects requiring management, and the resulting aging management activities for reinforced concrete pad No. 1 are provided in the following sections:

- Section 3.4.1, Materials Evaluated
- Section 3.4.2, Environments
- Section 3.4.3, Aging Effects Requiring Management
- Section 3.4.4, Aging Management Program

The results of the aging management review for reinforced concrete pad No. 1 are provided in Table AMR Results-3, Reinforced Concrete Pad No. 1.

2.5 Identification of In-scope Subcomponents Requiring AMR

The TN-32 dry storage cask, spent fuel assemblies, and reinforced concrete pad No. 1 were further reviewed to identify the subcomponents that support the SSC intended functions. The subcomponents and associated intended functions were identified by reviewing the documentation sources listed in Section 2.2.2, Documentation Sources Used for Scoping Process.

Table AMR Results-1, Transnuclear TN-32 Dry Storage Cask; Table AMR Results-2, Spent Fuel Assemblies; and Table AMR Results-3, Reinforced Concrete Pad No. 1 identify the intended functions for the subcomponents of the Transnuclear TN-32 dry storage cask, spent fuel assemblies, and reinforced concrete pad No. 1 subcomponents, respectively, that require AMR. The tables also identify subcomponents that did not support the SSC intended function and are not in the scope of license renewal.

2.5.1 Subcomponents Excluded from License Renewal

The following TN-32 dry storage cask, spent fuel assembly and reinforced concrete pad No. 1 SSCs do not support a license renewal intended function. They are, therefore, excluded from the scope of license renewal.

2.5.1.1 Overpressure Tank, Isolation Valve, Tubing, Pressure Sensors, Overpressure Port Cover, Bolts, and Seal

The overpressure tank, isolation valve, sensors, and associated tubing provide pressure differential between the TN-32 dry storage cask lid and penetration seals that is greater than the TN-32 dry storage cask internal pressure and greater than atmospheric pressure. The overpressure connection in the cask lid is sealed by an overpressure port cover, bolts, and seal. Redundant pressure switches are used to monitor the pressure between the lid and lid penetration seals. A failure of any overpressure system component will not result in failure of a confinement barrier and subsequent leakage of radioactivity to the outside atmosphere. Additionally, the TN-32 Dry Storage Cask Topical Safety Analysis Report, (Reference 4.5) does not identify the overpressure port as being part of the confinement boundary. As noted in Table 2.3-2, Scoping Results, the NRC staff has previously accepted overpressure monitoring system components as not important to safety.

2.5.1.2 External Coating

The coating applied to the exterior surfaces of the TN-32 dry storage cask is exposed to atmospheric conditions. Operating experience has shown that this external coating can be damaged during dry storage cask handling operations and long-term exposure to atmospheric conditions. No credit is taken (with respect to aging management) for the external coating applied to the TN-32 dry storage casks. It is, therefore, excluded from the scope of license renewal.

2.5.1.3 Protective Cover, Subassembly, Bolts, and Seal

The protective cover, bolts and seal provide weather protection to the components located beneath the cover. A plate in the cover, referred to as the "subassembly," allows access under the cover without removing the cover. Tubing for the overpressure system penetrates the subassembly. The protective cover is sealed to the TN-32 dry storage cask flange using a Viton seal and bolts. Operating experience has shown moisture can penetrate the protective cover. For the purpose of license renewal, therefore, no credit is taken for the cover as a form of weather protection.

The protective cover was originally credited in the tornado missile analysis for the TN-32 dry storage cask. As stated in Section A.1.7 of the ISFSI SAR (Reference 4.6), the missile analysis has been revised, eliminating the protective cover from the analysis. Appendix A.1, Attachment 2 of the ISFSI SAR contains the revised missile analysis.

2.5.1.4 Drain Tube

The drain tube is provided for removing water from the TN-32 dry storage cask following cask loading and does not provide a cask pressure boundary. The drain tube is equipped with a quick disconnect just below the drain port cover and extends to the bottom of the dry storage cask interior. The drain tube performs an operational function, but no safety function.

2.5.1.5 Vent and Drain Port Quick Disconnects

These components are not part of the TN-32 dry storage cask pressure boundary. In the event of quick disconnect failure; at least two seals remain functional to ensure dry storage cask pressure boundary integrity. These components are, therefore, excluded from further evaluation since these subcomponents do not perform a license renewal intended function.

2.5.1.6 Fuel Assembly Inserts

Fuel assembly inserts are any devices inserted in the fuel assembly guide tubes. These devices include burnable poison assemblies, thimble plugs, control rods, and secondary sources. None of the fuel assembly inserts perform a license renewal intended function.

2.5.1.7 Fuel Pellets

The fuel pellets are stacked within the fuel cladding and do not perform a license renewal intended function. The pellets may have sufficient cracking to have degraded into numerous pieces, rather than their original cylindrical shape. The pieces of pellets will be contained within the fuel cladding. It is the fuel cladding, not the fuel pellets that ensures the fuel remains in a subcritical, coolable geometry.

2.5.1.8 Fuel Rod Springs

The fuel rod springs are internal to the fuel cladding. They are used during initial shipping of the fuel to hold the fuel pellets in place. They do not perform any of the license renewal intended functions.

2.5.1.9 Protective Grid Assembly

The protective grid (P-grid) is located near the bottom nozzle and is used to protect the fuel rods from debris during power operation. It does not perform any of the license renewal intended functions.

2.5.1.10 Instrument Tube

The instrument tube provides alignment for the in-core instrument guide thimbles within designated fuel assemblies. It does not provide any of the license renewal intended functions.

2.5.1.11 Nozzle Spring Set

The nozzle spring set is part of the upper nozzle on the fuel assembly. It is compressed when the reactor vessel head is installed and is used to limit axial motion of the fuel assembly. The nozzle spring set provides no function once installed in the TN-32 dry storage cask and is excluded from the scope of license renewal on this basis.

2.5.1.12 Reinforced Concrete Pad No. 1 Joint Sealant

Deterioration of the joint sealant will not impact the intended functions of reinforced concrete pad No. 1. Joint sealant, therefore, is excluded from the scope of license renewal.

2.5.1.13 Electrical Junction Boxes and Conduits

The intended functions of reinforced concrete pad No. 1 and the TN-32 dry storage cask are not dependent upon lighting or electrical power to the low pressure alarm switches. The overpressure system pressure switches are not important to safety (Refer to Section 2.5.1.1). The associated junction boxes and conduits, therefore, are excluded from the scope of license renewal.

Table 2.2-1 ISFSI 10 CFR 72.48 Evaluations

Approval Date	Evaluation Number	Evaluation Summary
07/09/1998	98-SE-OT-39	Revised a SAR drawing to include the use of a fillet weld as an alternative to the groove weld on the periphery of the fuel basket. The SAR update was performed to reflect as-built conditions.
07/09/1998	98-SE-OT-40	Revised the TN-32 cask normal operating surface dose rates and 1 meter dose rates to be consistent with the SER. The revised dose rates were bounded by Technical Specification limits.
03/18/1999	99-SE-OT-09	Modified the SAR to reflect the storage of burnable poison rod assemblies and thimble plugging devices in the TN-32 casks. A Technical Specification Amendment was required prior to implementation.
10/05/1999	99-SE-OT-51	Revised a drawing to permit the use of a partial penetration weld vice a full penetration weld on the outer wrapper of the TN-32 cask fuel basket.
10/05/1999	99-SE-OT-52	Revised the ISFSI SAR to include a discussion of a 0.12 inch position change of the borated aluminum plates in the fuel basket.
08/10/2000	00-SE-OT-44	Revised a SAR figure to remove a fence and gate at the Service Water Pump House from the figure.
03/12/2001	01-SE-OT-06	Modified the tornado missile analysis contained in the SAR to remove the protective cover from the analysis, such that no credit would be taken for having the protective cover in place.
03/12/2001	01-SE-OT-08	Modified the location of ISFSI fire extinguishers as shown in the SAR.
05/31/2001	01-SE-OT-17	Revised the SAR to include new cask lid bolt torque values, use of Loctite N-5000 lubricant, and use of silver jacketed lid seals based on recommendations from Transnuclear.
06/21/2001	01-SE-MOD-01	Revised the SAR to include a description of the modified cask protective covers. The covers were modified to prevent water intrusion under the cover.
10/18/2002	02-SE-OT-04	Revised the fuel basket rail structural analysis in the SAR. The range of as-built gaps between center basket rails was greater than listed in the SAR. The revised analysis demonstrated the structural integrity of the fuel basket and rails is maintained with the as-built gaps.

Table 2.3-2 Scoping Results

SSC[1]	Category 1	Category 2	In-Scope	Reference / Comment
TN-32 Dry Storage Cask	Y	N/A	Y	ISFSI SAR Section 3.2 - Important to safety. The SER (Reference 4.8) confirms that the TN-32 dry storage cask is important to safety.
Spent Fuel Assemblies	Y	N/A	Y	Important to safety. Neither the ISFSI SAR nor the SER refer to the safety classification of the spent fuel assemblies. The spent fuel assemblies are safety-related components that support license renewal intended functions, e.g., retrievability.
Reinforced Concrete Pad No. 1	N	Y	Y	ISFSI SAR - Not important to safety. ISFSI SAR - Section 4.1 and Section 4.2 indicates that reinforced concrete pad No. 1 is "nonsafety-related." Reinforced concrete pad No. 1 therefore, does not meet Category 1 criterion. ISFSI SAR Section 4.2.1 refers to concrete strength as being a factor in design accidents. Reinforced concrete pad No. 1 is therefore, in the scope of license renewal since it meets Category 2 criterion.
Transporter and Supporting Equipment	N	N	N	ISFSI SAR - Not important to safety. The ISFSI SAR and SER do not identify any components associated with the transporter as important to safety.
Lift Beam and Lid Handling Tools	N	N	N	ISFSI SAR Section 4.5 - Important to safety. The ISFSI SER confirms the lift beam and lid handling tools are important to safety. These components, however, are only used during cask loading and unloading operations in the Fuel Building and Decontamination Building. Section 1.1 and Section 5.1.1.1 of the ISFSI SAR identify cask handling operations conducted inside the site Fuel and Decontamination Buildings as being performed in accordance with the 10 CFR Part 50 operating license. This is also explicitly stated in the ISFSI Material License (Reference 4.11). The cask lift beam and cask lid handling tools are included in the Heavy Loads Program, which is an AMP credited for 10 CFR Part 54 license renewal. The lift beam and lid handling tools are, therefore, excluded from 10 CFR Part 72 license renewal.

Table 2.3-2 Scoping Results

SSC[1]	Category 1	Category 2	In-Scope	Reference / Comment
TN-32 dry storage cask Overpressure Instrumentation	N	N	N	ISFSI SAR - Not important to safety. The ISFSI SAR Section 4.4.5.3 states: "This instrumentation is not required for safe operation of the ISFSI ..." Additionally, the functionality of this active equipment is monitored in accordance with Technical Specifications on a frequency that ensures that any loss of inter-lid pressure will be detected in a timely manner. Interim Staff Guidance SFST-ISG-5, Confinement Evaluation states "The staff has accepted monitoring systems as not important to safety..." (Reference 4.12, p6)
Radiological Alarm Systems, Including Panels	N	N	N	The North Anna ISFSI is not provided with radiological alarm systems and panels. (Reference 4.6, Table 4-1)
Lighting	N	N	N	ISFSI SAR - Not important to safety. With regard to loss of lighting, the ISFSI SAR states "This event has no safety or radiological consequences" (Refer to ISFSI SAR Section 8.1.1.3).
Backup Diesel Generator (Electrical Power Supplies) and Fuel Oil Tank	N	N	N	ISFSI SAR - Not important to safety. With regard to loss of electrical power, the ISFSI SAR states "This event has no safety or radiological consequences." This position is supported by the fact that none of the supplied electrical loads meet Criterion 1 or 2 (Refer to ISFSI SAR Section 8.1.1.3). Additionally, the fuel oil tank is not considered in the fire accident analysis. The ISFSI SAR Section 3.3.6, states "To prevent a postulated fire associated with a leaking fuel oil tank a monitored, double-walled fuel tank with a maximum capacity of 200 gallons is provided. There are no other significant combustible sources within the ISFSI fence."
Security Fence	N	N	N	ISFSI SAR - Not important to safety. The ISFSI SAR Section 4.5 describes the security fence as not important to safety.
Earth Berm	N	N	N	The ISFSI SAR Section 7.3.2 states: "An earth berm was constructed inside the north and east perimeter fences of the ISFSI to reduce direct radiation." The berm is not addressed in Technical Specifications or the Safety Evaluation Report. Additionally, the 10 CFR Parts 20, 72.104 and 72.106 dose analyses do not credit the berm as providing shielding.

1. See Table AMR Results-1, Table AMR Results-2, and Table AMR Results-3 for SSC intended functions.

3.0 AGING MANAGEMENT REVIEWS

3.1 Aging Management Review Methodology

The scoping process identified the dry storage cask, spent fuel assemblies, and reinforced concrete pad No. 1 as individual SSCs that are within the scope of license renewal and require evaluation in the aging management review (AMR) process.

The AMR process involved the following three (3) major steps:

1. Identification of materials and environments for SSCs requiring AMR
2. Identification of aging mechanisms and effects requiring management
3. Determination of the activities required to manage the effects of aging

Each of these steps is discussed in Section 3.1.1 through Section 3.1.3, respectively.

The results of the aging management review for the subcomponents of the dry storage cask, spent fuel assemblies, and reinforced concrete pad No. 1 are provided in:

- Section 3.2, Aging Management Review Results - Dry Storage Cask
- Section 3.3, Aging Management Review Results - Spent Fuel Assemblies
- Section 3.4, Aging Management Review Results - Reinforced Concrete Pad No. 1

3.1.1 Identification of Materials and Environments

The first step of the AMR process involved the identification of the materials of construction and the environments to which these materials are exposed, for the subcomponents that require an AMR.

The materials of construction have been determined from the references identified in Sections 3.2, 3.3, and 3.4. A summary of the materials of construction is provided in Section 3.2.1 for the TN-32 dry storage cask, Section 3.3.1 for the spent fuel assemblies and Section 3.4.1 for reinforced concrete pad No. 1. The specific materials of construction for TN-32 dry storage cask, spent fuel assemblies, and reinforced concrete pad No. 1 requiring aging management review are reflected in the AMR results tables.

The casks are provided with an external coating. Although the coating may be designed to inhibit degradation of the underlying material, it is not credited in the AMR for the exclusion of aging effects requiring management.

The environments considered are the environments that the SSCs in the scope of license renewal can be reasonably expected to experience. They are based on plant-specific references and operating experience. Descriptions of the internal and external environments, which have been used in the aging management review, are included in Section 3.2.2 for the TN-32 dry storage cask, Section 3.3.2 for the spent fuel assemblies and Section 3.4.2 for reinforced concrete pad No 1, and are reflected in the AMR results tables.

Environmental stressors that are not conditions normally experienced, or that may be caused by a design error (such as inadequate design analysis), are called event-driven or service-driven situations and have not been characterized as sources of aging. As such, they will be evaluated and corrective action implemented at the time of the event.

3.1.2 Identification of Aging Mechanisms and Effects Requiring Management

The second step in the AMR process involved the identification of aging effects and associated mechanisms requiring management pertinent to the SSCs within the scope of license renewal. The aging effects requiring management are those that could result in a loss of intended function.

The aging effects and associated mechanisms are based on those identified in:

- Aging Effects for Structures and Structural Components (Structural Tools), EPRI Report 1015078, Revision 2. (Reference 4.13)
- Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, EPRI Report 1010639, Revision 4. (Reference 4.15)
- EPRI Report No. 1003010, October 2001, Dry Cask Storage Characterization Project. (Reference 4.16)
- ASTM Standard C1562-10, Standard Guide for Evaluation of Materials Used in Extended Service of Interim Spent Nuclear Fuel Dry Storage System, ASTM International. (Reference 4.17)
- Spent Fuel Project Office Interim Staff Guidance SFST-ISG-11, Revision 3, Cladding Considerations for the Transportation and Storage of Spent Fuel, November 17, 2003, Nuclear Regulatory Commission. (Reference 4.18)
- NUREG-1801, Generic Aging Lessons Learned (GALL) Report, Rev. 2. ML103490041 (Reference 4.23)
- NUREG/CR-6831, Examination of Spent PWR Fuel Rods after 15 Years in Dry Storage, 2003, Argonne National Laboratory. ML032731021 (Reference 4.24).
- NUREG/CR-6673, Hydrogen Generation in TRU Waste Transportation Packages, UCRL-ID-13852, May 2000. ML003723404 (Reference 4.25)
- Certified Test Report for Heat No. 7035, Lot ID 766-1, Laboratory Testing, Inc., Dublin, PA, September 30, 1999. (Reference 4.26)

The aging effects have been presented in terms of material and environment combinations. The information is applied to subcomponents, regardless of form, e.g., cask body, cover, lid, etc.

Aging effects are the manifestation of aging mechanisms. In order to effectively manage an aging effect, it was necessary to first determine the aging mechanisms that are potentially plausible for a given material and environment application. The AMR process addressed both the aging effects and the associated aging mechanism for each material and environment combination without consideration of the form or function of the subcomponent(s). The industry references listed above identify the specific environmental conditions required for aging mechanisms to be considered applicable for a given aging effect. If the conditions necessary for an aging mechanism are not present, the resulting aging effect (from the particular mechanism) was not considered further in the AMR process.

A summary of aging effects requiring management is provided in Section 3.2.3, Section 3.3.3, and Section 3.4.3 for the TN-32 dry storage cask, spent fuel assemblies, and reinforced concrete pad, respectively.

Based on a review of NUREG-1801, Generic Aging Lessons Learned (GALL) Report (Reference 4.23), there are multiple ways to describe concrete aging effects. Table 3.1-1, Concrete Aging Effect/Mechanism Cross-Reference, provides a cross-reference between the aging effects listed in the GALL Report and those listed in Aging Effects for Structures and Structural Components (Structural Tools) (Reference 4.13) for concrete exposed to Soil and Atmosphere/Weather environments.

Table 3.1-1 Concrete Aging Effect/Mechanism Cross-Reference

Aging Effect/Mechanism		Discussion
GALL (Reference 4.23)	Structural Tools Reference 4.13, Tables 5-2 and 5-3	
Cracking and distortion due to increased stress levels from settlement	Cracking due to settlement	Direct match
Cracking due to expansion from reaction with aggregates	Cracking due to reaction with aggregates	Direct match
Cracking; loss of bond; and loss of material (spalling, scaling) due to corrosion of embedded steel	Loss of Material due to corrosion of embedded steel	Loss of material due to corrosion of embedded steel can lead to cracking and loss of bond. The Structural Tools aging effect/mechanism is, therefore, an acceptable match to the GALL Report. Refer to Reference 4.13, Section 5.3.1.5 for further clarification.
Increase in porosity and permeability; cracking; loss of material (spalling, scaling) due to aggressive chemical attack	Loss of Material and Change in Material Properties due to aggressive chemicals	Loss of material and change in material properties due to aggressive chemicals can lead to cracking and increased porosity and permeability. The Structural Tools aging effect/mechanism is, therefore, an acceptable match to the GALL Report. Refer to Reference 4.13, Sections 5.3.1.4 and 5.3.3.2 for further clarification.
Loss of material (spalling, scaling) and cracking due to freeze-thaw	Loss of material due to freeze-thaw, Cracking due to freeze-thaw	Direct match
Increase in porosity and permeability; loss of strength due to leaching of calcium hydroxide and carbonation	Change in material properties due to leaching of calcium hydroxide	An increase in porosity and permeability, and loss of strength are changes in material properties. The Structural Tools aging effect/mechanism is, therefore, an acceptable match to the GALL Report. Refer to Reference 4.13, Section 5.3.3.1 for further clarification.

3.1.3 Determination of the Activities Required to Manage the Effects of Aging

The final step in the AMR process involved the determination of the Aging Management Programs (AMPs) to be credited with managing the effects of aging. The aging management activities credited with managing loss of material for the applicable cask subcomponents are described in Appendix A, Section A2.1, TN-32 Dry Storage Cask Aging Management Program. There are no aging effects requiring management for the spent fuel assemblies in the TN-32 dry storage cask storage environment as indicated in Section 3.3.3. The aging management activities credited with managing loss of material, cracking, and change in material properties for reinforced concrete pad No. 1 are described in Appendix A, Section A2.2, Monitoring of Structures Aging Management Program.

3.1.4 Confirmation of the AMR Process through Operating Experience Review

As described in Section 3.1.2, plausible aging effects and mechanisms were determined from standard industry references such as the EPRI Non-Class 1 Mechanical Implementation Guidelines and Mechanical Tools. Reviews of industry and plant-specific operating experience were conducted to confirm the results of the AMR process.

3.1.5 Documentation Sources Used for AMR Process

Information from drawings, technical reports, and licensing documents have been reviewed during the AMR process as required to obtain clarifications of the intended functions performed by the ISFSI subcomponents in the scope of license renewal.

Refer to Sections 3.2, 3.3, and 3.4 for the specific sources of information used during the AMR of the TN-32 dry storage cask, spent fuel assemblies, and reinforced concrete pad No. 1, respectively. The documentation sources listed in Section 2.2.2, Documentation Sources Used for Scoping Process, have also been used in the AMR process.

3.2 Aging Management Review Results - Dry Storage Cask

This section provides the results of the aging management review of the subcomponents determined to require aging management as identified in Section 2.3, Scoping Results.

A summary of the results of the aging management review for the TN-32 dry storage cask subcomponents is provided in Table AMR Results-1, Transnuclear TN-32 Dry Storage Cask. The table provides the following information related to each TN-32 dry storage cask subcomponent determined to require aging management review: (1) intended function, (2) material group, (3) environment, (4) aging effects, (5) mechanism, and (6) aging management programs that manage the applicable aging effects.

A pre-application inspection of a cask bottom and beneath the protective cover of a cask was completed in Fall 2015. The results of the inspection were considered in the aging management review. Refer to Section F2.0, Pre-application Inspection. The results of pre-application inspections performed at Prairie Island were also reviewed.

Aging of welds associated with the SSCs listed in Table AMR Results-1, Transnuclear TN-32 Dry Storage Cask is managed using the same aging management program as the parent component.

A description of TN-32 dry storage cask SSCs is provided in Section 2.4.1 and a summary of the materials and environments is provided in Section 3.2.1 and Section 3.2.2, respectively.

Section 3.2.3 and Section 3.2.4 provide a summary of the aging effects requiring management for the dry storage cask and the aging management programs used to manage the effects of aging, respectively.

3.2.1 Materials Evaluated

The materials of construction for the subcomponents (Reference 4.5, Table 1.2-2) of the TN-32 dry storage cask are listed below, See Table AMR Results-1, Transnuclear TN-32 Dry Storage Cask.

- Carbon and low-alloy steel
- Stainless steel
- Aluminum
- Polypropylene
- Borated polyester
- Silver
- Nickel-based alloy

3.2.2 Environments

External

The TN-32 dry storage casks are located at the ISFSI site, in Louisa County, Virginia. The TN-32 dry storage casks are exposed to an external atmosphere/weather environment. The atmosphere/weather environment includes precipitation, wind, ultraviolet radiation, and ozone. The cask external environment is bounded by an air temperature of -20°F to 115°F (ISFSI SAR, Section 2.3.2). Rainfall averages approximately 44 inches per year. Snowfalls of four inches or more occur an average of once per year and usually remain on the ground one to four days at a time (ISFSI SAR, Section 2.3.1).

Internal

The TN-32 dry storage cask is designed for a maximum heat load of 32.7 kW (Reference 4.6, Section A.1.4) and maximum cladding temperature of 658°F (348°C) (Reference 4.5). Following cask loading, the TN-32 dry storage cask is procedurally evacuated and filled with helium gas to a pressure no greater than 2,330 mbar.

The internal environment could potentially contain fission product gases as well (Reference 4.17). These gases are included in the helium environment.

The average cask internal gas temperature is expected to be 378°F (192°C) after initial loading and decrease to 262°F (128°C) after 20 years (Reference 4.5).

After 20 years of dry storage, the fast neutron fluence and gamma radiation levels are expected to be approximately 10^{14} n/cm^2 and 10^9 rad, respectively.

The dry storage cask is exposed to borated water during fuel loading. This water is removed following fuel loading. Borated water is, therefore, not considered an environment during long-term storage.

3.2.3 Aging Effects Requiring Management

The following aging effect, associated with the TN-32 dry storage cask, requires management:

- Loss of Material

A review of site-specific and industry operating experience related to the ISFSI has been conducted to identify any aging effects that had not previously been addressed. This review did not identify any other aging effects that were not considered during the aging management review. The pre-application inspection results contained in Element 10 for the aging management program support this conclusion. Refer to Section F2.0, Pre-application Inspection. The operating experience review results described below, however, confirmed the need for periodic inspections in accordance with the TN-32 Dry Storage Cask Aging Management Program to provide reasonable assurance that the TN-32 dry storage cask will perform its intended function(s) throughout the period of extended operation. Refer to Cask AMP Element 10.

- Instances of cask external coating degradation, e.g., flaking on the TN-32 dry storage casks has been identified. Refer to Cask AMP Element 10, Visual Inspections Operating Experience.
- The TN-32 dry storage cask outer metallic seals have experienced loss of material due to the intrusion of rainwater in the vicinity of the outer metallic seal. Refer to Cask AMP Element 10, Interseal Pressure Monitoring Operating Experience.

3.2.4 Aging Management Program

The TN-32 Dry Storage Cask Aging Management Program manages the aging effect of loss of material for the subcomponents of the TN-32 dry storage cask identified in Table AMR Results-1, Transnuclear TN-32 Dry Storage Cask.

A description of this aging management program is provided in Appendix A, Section A2.1 along with the demonstration that the identified aging effect will be effectively managed for the period of extended operation.

3.2.5 Conclusion

Based on the aging management activities provided in the TN-32 Dry Storage Cask Aging Management Program, loss of material associated with the TN-32 dry storage cask subcomponents will be adequately managed so that there is reasonable assurance that the intended function(s) will be maintained consistent with the design basis during the period of extended operation.

3.3 Aging Management Review Results - Spent Fuel Assemblies

This section provides the results of the aging management review for the spent fuel assemblies that were identified in Section 2.3, Scoping Results, as being subject to aging management review.

A summary of aging management review results of the ISFSI spent fuel assemblies is provided in Table AMR Results-2, Spent Fuel Assemblies. The table provides the following information related to each subcomponent determined to be within the scope of license renewal: (1) intended function, (2) material group, (3) environment, (4) aging effect, (5) mechanism, and (6) aging management programs that manage the applicable aging effects.

Fuel assemblies were used in a study by Idaho National Engineering and Environmental Laboratory and Argonne National Laboratory to determine the aging effects on fuel in dry storage casks. At that time, the fuel assemblies had been in dry storage casks for over fourteen years. A visual examination and a material analysis were performed on the fuel assemblies. The results of this study were included in EPRI's Dry Cask Storage Characterization Project, Final Report (Reference 4.16). This project identified and examined several questions concerning fuel behavior during dry cask storage. The results of this analysis were considered in aging management review of the spent fuel assemblies presented in this section. Additional documents considered in the AMR process include:

- Interim Staff Guidance SFST-ISG-11, Cladding Considerations for the Transportation and Storage of Spent Fuel (Reference 4.18)
- NUREG/CR-6831, Examination of Spent PWR Fuel Rods after 15 Years in Dry Storage (Reference 4.24)
- NUREG-1801, Generic Aging Lessons Learned (GALL) Report (Reference 4.23)

3.3.1 Materials Evaluated

The materials of construction for the spent fuel assembly subcomponents that are subject to aging management review are zirconium-based alloy, nickel-based alloy, and stainless steel (Reference 4.10, Chapter 4; and vendor drawings).

3.3.2 Environments

Internal

The fuel cladding and guide tubes are the only two fuel assembly subcomponents that have internal environments. The guide tubes are open on the end and are exposed to the cask helium fill gas on the internal and external surfaces.

The fuel cladding internal environment is a combination of helium and potentially fission product gases (Reference 4.17, Section A.2.2.2.1). The initial helium fill gas pressure in PWR fuel rods is between 200 and 500 psia at 20°C (Reference 4.17, Section A.2.2.2.1). The fuel rod internal pressure during cask storage depends upon fuel temperature, void volume inside the fuel tube, and cladding integrity. Following initial cask loading, the fuel cladding temperature is expected to be less than 565°F (313°C) (Reference 4.6, Section A.1.4). After 20 years of dry storage, the fuel cladding temperature is expected to be less than 371°F (188°C) (Reference 4.5, Table 4.4-1).

The North Anna ISFSI Technical Specifications limits the average burnup of the stored assemblies to ≤ 45,000 MWD/MTU (Reference 4.7, Table 2.1-1). The ISFSI Technical Specification limits on cask vacuum drying times and pressure provide assurance that the peak cladding temperature of 400°C is not exceeded (Reference 4.7, Section B.3.1.1), which is consistent with the temperature limits for low-burnup fuel specified in Interim Staff Guidance SFST-ISG-11, Cladding Considerations for the Transportation and Storage of Spent Fuel (Reference 4.18).

External

The spent fuel assembly external environment is the same as the TN-32 dry storage cask internal environment described in Section 3.2.2.

3.3.3 Aging Effects Requiring Management

Based on a review of the environments of the spent fuel assemblies and the materials of construction, there are no aging effects requiring management during the period of extended operation for the spent fuel assembly subcomponents subject to aging management review. This is consistent with the EPRI Dry Cask Storage Characterization Project, final report (Reference 4.16), which did not identify any evidence of aging degradation of low-burnup fuel assembly subcomponents from the time of initial loading up to the time of testing.

3.3.4 Aging Management Program

There are no Aging Management Activities required during the period of extended operation for the spent fuel assembly subcomponents subject to aging management review.

3.3.5 Conclusion

There are no aging management activities required during the period of extended operation for the spent fuel assembly subcomponents.

The intended function(s) of the spent fuel assemblies, therefore, will be maintained consistent with the design basis during the period of extended operation.

3.4 Aging Management Review Results - Reinforced Concrete Pad No. 1

This section provides the results of the AMR for reinforced concrete pad No. 1 SSCs that were identified in Section 2.3, Scoping Results, as being subject to aging management review.

A summary of the results of the AMR is provided in Table AMR Results-3, Reinforced Concrete Pad No. 1. The table provides the following information related to the subcomponent determined to be within the scope of license renewal: (1) intended function, (2) material group, (3) environment, (4) aging effect, (5) mechanism, and (6) aging management programs that manage those aging effects.

3.4.1 Materials Evaluated

The materials of construction for reinforced concrete pad No. 1 subcomponents that are subject to aging management review are concrete and reinforcing steel. Reinforced concrete pad No. 1 is constructed of ready mixed concrete. The cement used in the concrete mix conforms to ASTM C150, Type II, with a water-to-cement ratio not to exceed 0.50. Air-entraining admixtures conforming to ASTM C260 (Reference 4.19) and water-reducing admixtures conforming to ASTM C494 (Reference 4.20) have been used to help resist the effects of freeze-thaw cycling on the concrete. The fine and coarse aggregates of the concrete mix conform to the requirements of ASTM C33 (Reference 4.21). The aggregates have been kept free of any material that may cause excessive expansion of the mortar or concrete. The reinforcing steel consists of deformed steel bars made from carbon steel. The strength of reinforced concrete pad No. 1 was calculated in accordance with the requirements and assumptions of ACI 349-85 (Reference ISFSI SAR, Section 4.2.1 and Reference 4.22) and construction of reinforced concrete pad No. 1 also meets the requirements of ACI 301-89 (Reference ISFSI SAR, Section 4.2.1 and Reference 4.14).

3.4.2 Environments

The two environments associated with reinforced concrete pad No. 1 include:

- Atmosphere/Weather
- Soil

Atmosphere/Weather

The atmosphere/weather environment includes precipitation and wind and is bounded by an extreme air temperature range of -20°F to 115°F (Reference ISFSI SAR, Section 2.3.2). Rainfall averages approximately 44 inches per year and is fairly well distributed throughout the year. Snowfalls of four inches or more occur an average of once per year, and usually remains on the ground one to four days at a time (Reference ISFSI SAR, Section 2.3.1).

Soil

Soils are aggregates of mineral particles. The soil environment is based on the size of the soil particles and is commonly referred to as gravel, sand, silt, or clay, depending on the particle size. Soil can be either damp or dry and may include groundwater.

Groundwater may contain chemical constituents which can be acidic or contain chlorides and sulfates. The external environment exposure to atmospheric releases of chlorides and sulfur-based acid rain from industrial and chemical plants has an influence on surface and groundwater constituents. The NAPS site is located in a rural area of Virginia, on freshwater Lake Anna, and is not located near industrial or chemical plants (Reference ISFSI SAR, Section 2.2.1); therefore, the site is not exposed to brackish water, saltwater spray, or high-sulfur emissions. The physical location of the ISFSI on the NAPS site is approximately 2,000 linear feet from the Units 1 and 2 Protected Area (Reference ISFSI SAR, Section 2.1.1). Since the external environment exposure to atmospheric releases is the same for both locations, the surface and groundwater constituents should be similar.

Summary of the data for groundwater sampling results taken from the NAPS site between years 1992-2016 are provided in Table 3.4-2, Groundwater Sample Results Summary. The results for chlorides and sulfates of approximately 80% of 81 samples taken in the Protected Area between years 2007-2015 were recorded at <100 ppm. All 97 groundwater samples taken from 1992 through 2016 are within the acceptable range for non-aggressive groundwater, i.e., chlorides <500 ppm, sulfates <1,500 ppm, and pH > 5.5 (Reference 4.13). It is concluded that the groundwater sample results taken from two wells at the ISFSI site and in the Protected Area are similar, and are both considered to be representative across the NAPS site.

Table 3.4-2 Groundwater Sample Results Summary

Timeframe	Parameter	Result	Acceptable Range
1992, 1995, 1998, 2000 (14 samples)	Chlorides	1.9-28.0 ppm	<500 ppm
	Sulfates	4.4-33.0 ppm	<1,500 ppm
	pH	6.76-10.80	>5.5
2007-2015 (81 samples)	Chlorides	<100 ppm	<500 ppm
	Sulfates	<100 ppm	<1,500 ppm
	pH	5.92-11.94	>5.5
2016 (2 samples at ISFSI)	Chlorides	2.0, 2.3 ppm	<500 ppm
	Sulfates	1.3, 2.3 ppm	<1,500 ppm
	pH	6.14, 7.04	>5.5

Five monitoring wells installed at locations across the ISFSI site show depths of groundwater measured at Elevation 289 to 296 feet msl (mean sea level) (Reference ISFSI SAR, Section 2.5.1.9). The bottom of reinforced concrete pad No. 1 at Elevation 309.3 feet msl, is 13 to 20 feet above the groundwater table. Thus reinforced concrete pad No. 1 is not exposed to groundwater in the soil environment.

3.4.3 Aging Effects Requiring Management

Based on a review of the environment of reinforced concrete pad No. 1 and the materials of construction, the following aging effects associated with reinforced concrete pad No. 1 require management:

- Loss of Material
- Cracking
- Change in Material Properties

3.4.4 Aging Management Program

The Monitoring of Structures Aging Management Program manages the aging effect of loss of material, cracking, and change in material properties for the subcomponents of reinforced concrete pad No. 1 identified in Table AMR Results-3, Reinforced Concrete Pad No. 1.

A description of this aging management program for reinforced concrete pad No. 1 is provided in Appendix A, Section A2.2 along with the demonstration that the identified aging effects will be effectively managed for the period of extended operation.

3.4.5 Conclusion

Based on the aging management program provided in Monitoring of Structures Aging Management Program, loss of material, cracking, and change in material properties aging effects associated with reinforced concrete pad No. 1 subcomponents will be adequately managed so that there is reasonable assurance that the intended function(s) will be maintained consistent with the design basis during the period of extended operation.

AGING MANAGEMENT REVIEW RESULTS TABLES

See Section 2.2.1 for Intended Function Code Definitions.

Table AMR Results-1 Transnuclear TN-32 Dry Storage Cask

Subcomponent	Intended Function	Material Group	Environment (E) external, (I) internal	Aging Effect	Mechanism	Aging Management Program
Cask Shell	PB, SS, RS, HT	Carbon Steel	(I) Air [2]	None	N/A	N/A
			(E) Atmosphere / Weather[1]	Loss of Material	Crevice Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Pitting Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Galvanic Corrosion	TN-32 Dry Storage Cask Aging Management Program
					General Corrosion	TN-32 Dry Storage Cask Aging Management Program
Lid and Shield Plate (includes stainless steel weld overlays)	PB, SS, RS, HT, RT	Stainless Steel	(E) Atmosphere / Weather	Loss of Material	Crevice Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Pitting Corrosion	TN-32 Dry Storage Cask Aging Management Program
			(I) Helium	None	N/A	N/A
		Carbon Steel and Low-Alloy Steel [4]	(I) Helium	None	N/A	N/A
			(E) Atmosphere / Weather[1]	Loss of Material	Crevice Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Pitting Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Galvanic Corrosion	TN-32 Dry Storage Cask Aging Management Program
					General Corrosion	TN-32 Dry Storage Cask Aging Management Program
Inner Containment (includes sprayed aluminum coating)	PB, SS, RS, HT	Low-Alloy Steel	(E) Air [2]	None	N/A	N/A
		Aluminum	(I) Helium	None	N/A	N/A
Cask Bottom	PB, SS, RS, HT	Carbon Steel	(I) Air [2]	None	N/A	N/A
			(E) Atmosphere / Weather[1]	Loss of Material	Crevice Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Pitting Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Galvanic Corrosion	TN-32 Dry Storage Cask Aging Management Program
					General Corrosion	TN-32 Dry Storage Cask Aging Management Program
Bottom Containment (includes sprayed aluminum coating)	PB, SS, RS, HT	Low-Alloy Steel	(E) Air [2]	None	N/A	N/A
		Aluminum	(I) Helium	None	N/A	N/A
Trunnions	SS	Carbon Steel	(E) Atmosphere / Weather[1]	Loss of Material	Crevice Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Pitting Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Galvanic Corrosion	TN-32 Dry Storage Cask Aging Management Program
					General Corrosion	TN-32 Dry Storage Cask Aging Management Program

See Section 2.2.1 for Intended Function Code Definitions.

Table AMR Results-1 Transnuclear TN-32 Dry Storage Cask

Subcomponent	Intended Function	Material Group	Environment (E) external, (I) internal	Aging Effect	Mechanism	Aging Management Program
Outer shell	SS, RS	Carbon Steel	(E) Air [2]	None	N/A	N/A
			(E) Atmosphere / Weather[1]	Loss of Material	Crevice Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Pitting Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Galvanic Corrosion	TN-32 Dry Storage Cask Aging Management Program
					General Corrosion	TN-32 Dry Storage Cask Aging Management Program
Top Neutron Shield	RS	Polypropylene (encased in carbon steel)	(E) Air[2]	Loss of Material	Radiolytic Decomposition	TN-32 Dry Storage Cask Aging Management Program
					Thermal Degradation	TN-32 Dry Storage Cask Aging Management Program
Top Neutron Shield Enclosure	SS, RS	Carbon Steel	(E) Atmosphere / Weather[1]	Loss of Material	Crevice Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Pitting Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Galvanic Corrosion	TN-32 Dry Storage Cask Aging Management Program
					General Corrosion	TN-32 Dry Storage Cask Aging Management Program
			(I) Air [2]	None	N/A	N/A
Top Neutron Shield Bolts	SS	Low-alloy Steel	(E) Atmosphere / Weather	Loss of Material	Crevice Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Pitting Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Galvanic Corrosion	TN-32 Dry Storage Cask Aging Management Program
					General Corrosion	TN-32 Dry Storage Cask Aging Management Program
Radial Neutron Shield	RS	Borated Polyester (encased in aluminum)	(E) Air[2]	Loss of Material	Radiolytic Decomposition	TN-32 Dry Storage Cask Aging Management Program
					Thermal Degradation	TN-32 Dry Storage Cask Aging Management Program
Radial Neutron Shield Box	SS, RS, HT	Aluminum	(I) Air[2]	None	N/A	N/A
			(E) Air[2]	None	N/A	N/A
Lid Bolts	PB, SS, RT	Low-alloy Steel	(E) Atmosphere / Weather	Loss of Material	Crevice Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Pitting Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Galvanic Corrosion	TN-32 Dry Storage Cask Aging Management Program
					General Corrosion	TN-32 Dry Storage Cask Aging Management Program

See Section 2.2.1 for Intended Function Code Definitions.

Table AMR Results-1 Transnuclear TN-32 Dry Storage Cask

Subcomponent	Intended Function	Material Group	Environment (E) external, (I) internal	Aging Effect	Mechanism	Aging Management Program
Lid Seals[3]	PB	Silver	(E) Helium	None	N/A	N/A
			(E) Atmosphere / Weather	Loss of Material	N/A	N/A
		Aluminum	(E) Helium	None	N/A	N/A
			(E) Atmosphere / Weather	Loss of Material	Crevice Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Pitting Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Galvanic Corrosion	TN-32 Dry Storage Cask Aging Management Program
		Nickel-Based Alloy	(I) Helium	None	N/A	N/A
Vent and Drain Port Covers	PB	Stainless Steel	(I) Helium	None	N/A	N/A
			(E) Atmosphere / Weather	Loss of Material	Crevice Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Pitting Corrosion	TN-32 Dry Storage Cask Aging Management Program
Vent and Drain Port Cover Bolts	PB, SS	Low-alloy Steel	(E) Atmosphere / Weather	Loss of Material	Crevice Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Pitting Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Galvanic Corrosion	TN-32 Dry Storage Cask Aging Management Program
					General Corrosion	TN-32 Dry Storage Cask Aging Management Program
Vent and Drain Port Cover Seals [3]	PB	Aluminum	(E) Helium	None	N/A	N/A
			(E) Atmosphere / Weather	Loss of Material	Crevice Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Pitting Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Galvanic Corrosion	TN-32 Dry Storage Cask Aging Management Program
		Silver	(E) Helium	None	N/A	N/A
			(E) Atmosphere / Weather	None	N/A	N/A
		Nickel-Based Alloy	(E) Helium	None	N/A	N/A
Basket Rails	SS, RS, HT, CC, RT	Aluminum	(E) Helium	None	N/A	N/A
Fuel Basket (includes basket rail bolts, washers, and spacers)	SS, RS, HT, CC, RT	Stainless Steel	(E) Helium	None	N/A	N/A

See Section 2.2.1 for Intended Function Code Definitions.

Table AMR Results-1 Transnuclear TN-32 Dry Storage Cask

Subcomponent	Intended Function	Material Group	Environment (E) external, (I) internal	Aging Effect	Mechanism	Aging Management Program
Aluminum Plates	SS, RS, HT, CC, RT	Aluminum	(E) Helium	None	N/A	N/A
Poison Plates	SS, RS, HT, CC, RT	Aluminum (includes borated aluminum)	(E) Helium	None	N/A	N/A
Flange (includes stainless steel weld overlay)	SS, RS	Stainless Steel	(E) Atmosphere / Weather	Loss of Material	Crevice Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Pitting Corrosion	TN-32 Dry Storage Cask Aging Management Program
		Carbon Steel[1]	(I) Helium	None	N/A	N/A
			(E) Atmosphere / Weather	Loss of Material	Crevice Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Pitting Corrosion	TN-32 Dry Storage Cask Aging Management Program
					Galvanic Corrosion	TN-32 Dry Storage Cask Aging Management Program
					General Corrosion	TN-32 Dry Storage Cask Aging Management Program
Overpressure System (includes isolation valve, tubing, and pressure sensors, overpressure port cover, bolts and seal)						Excluded (See Section 2.5.1.1)
External Coating						Excluded (See Section 2.5.1.2)
Protective Cover (includes subassembly), Bolts, and Elastomer O-ring Seal						Excluded (See Section 2.5.1.3)
Drain Tube						Excluded (See Section 2.5.1.4)
Vent and Drain Port Quick Disconnects						Excluded (See Section 2.5.1.5)

1 The cask is provided with an external coating of paint. The aging management review does not take credit for the external coating.

2 Small gaps may exist where metal-to-metal or metal-to-polymer subcomponents interface. These gaps may contain air and are assigned an Air environment. The limited amount of oxygen in these locations will be depleted and oxidation will be arrested. Aging management of these interface locations, therefore, is not required.

3 The seal external material is either silver or aluminum.

4 The cask lid is low-alloy steel and is exposed to atmosphere/weather. The shield plate is carbon steel and is exposed to helium gas.

See Section 2.2.1 for Intended Function Code Definitions.

Table AMR Results-2 Spent Fuel Assemblies

Subcomponent	Intended Function	Material Group	Environment[1,2] (E) external, (I) internal	Aging Effects	Mechanism	Aging Management Program
Fuel Cladding	PB, SS, HT, CC, RT	Zirconium-Based Alloy	(E) Helium	None	N/A	N/A
			(I) Helium	None	N/A	N/A
Fuel Cladding End Plug (includes welds)	PB, SS, HT, CC, RT	Zirconium-Based Alloy	(E) Helium	None	N/A	N/A
Guide Tubes (includes sleeves)	SS, RT	Stainless Steel	(E) Helium	None	N/A	N/A
		Zirconium-Based Alloy	(E) Helium	None	N/A	N/A
Grid Assemblies (Except Protective Grid Assemblies)	SS, HT, CC, RT	Zirconium-Based Alloy	(E) Helium	None	N/A	N/A
		Nickel-Based Alloy	(E) Helium	None	N/A	N/A
Bottom and Top Nozzles	SS, RT	Stainless Steel	(E) Helium	None	N/A	N/A
Fuel Assembly Inserts	Excluded (See Section 2.5.1.6)					
Fuel Pellets	Excluded (See Section 2.5.1.7)					
Fuel Rod Springs	Excluded (See Section 2.5.1.8)					
Protective Grid Assembly	Excluded (See Section 2.5.1.9)					
Instrument Tube	Excluded (See Section 2.5.1.10)					
Nozzle Spring Set	Excluded (See Section 2.5.1.11)					

1 Trace amounts of fission product gases may also be present in the helium environment because the potential for minor fuel cladding defects exists.

2 Temperature and radiation have been considered as described in Section 3.3.2, Environments

See Section 2.2.1 for Intended Function Code Definitions.

Table AMR Results-3 Reinforced Concrete Pad No. 1

Subcomponent	Intended Function	Material Group	Environment (E) external, (I) internal	Aging Effect	Mechanism	Aging Management Program
Concrete Pad	SS	Concrete (Reinforced)	(E) Atmosphere / Weather	Loss of Material	Freeze-thaw	Monitoring of Structures Aging Management Program
				Cracking	Freeze-thaw	Monitoring of Structures Aging Management Program
					Reaction with Aggregates	Monitoring of Structures Aging Management Program
				Change in Material Properties	Leaching of Calcium Hydroxide	Monitoring of Structures Aging Management Program
			(E) Soil	Cracking	Reaction with Aggregates	Monitoring of Structures Aging Management Program
					Settlement	Monitoring of Structures Aging Management Program
Joint Sealant	Excluded (See Section 2.5.1.12)					
Cask Electrical Junction Boxes and Conduit	Excluded (See Section 2.5.1.13)					

See Section 2.2.1 for Intended Function Code Definitions.

Intentionally Blank

See Section 2.2.1 for Intended Function Code Definitions.

4.0 REFERENCES

4.1 NUREG-1927, Standard Review Plan for Renewal of Spent Fuel Dry Cask Storage System Licenses and Certificates of Compliance, Final Report, Rev. 0, Nuclear Regulatory Commission.

4.2 Letter from J. P. O'Hanlon, Senior Vice President, Nuclear, to D. A. Cool, Office of Nuclear Material Safety and Safeguards, NRC, dated May 9, 1995, with License Application for North Anna Power Station, Independent Spent Fuel Storage Installation.

4.3 Letter from D. A. Heacock, President and Chief Nuclear Officer, to Director, Division of Spent Fuel Management, Office of Nuclear Material Safety and Safeguards, NRC, dated December 2, 2015, Virginia Electric and Power Company, North Anna Power Station Independent Spent Fuel Storage Installations (ISFSIs) 10 CFR 72.30 Decommissioning Funding Plan. ML15342A039

4.4 Letter from Todd T. Brickhouse, Vice President and Treasurer, to Director, Division of Spent Fuel Management, Office of Nuclear Material Safety and Safeguards, NRC, dated December 15, 2015, Old Dominion Electric Cooperative, North Anna Power Station Independent Spent Fuel Storage Installations (ISFSIs) 10 CFR 72.30 Decommissioning Funding Plan. ML16020A001

4.5 TN-32 Dry Storage Cask Topical Safety Analysis Report, Rev. 9A, Transnuclear, Inc., December 1996.

4.6 North Anna Independent Spent Fuel Storage Installation Safety Analysis Report, Rev. 8, North Anna Power Station. ML14233A488

4.7 Technical Specifications, Independent Spent Fuel Storage Installation, Amendment 4, North Anna Power Station.

4.8 Safety Evaluation Report, North Anna Independent Spent Fuel Storage Installation, June 1998.

4.9 Safety Evaluation Report for the Transnuclear Inc. Dry Storage Cask (TN-32) Docket 72-1021, November 1996.

4.10 North Anna Power Station Updated Final Safety Analysis Report, Rev. 51, North Anna Power Station.

4.11 Materials License No. SNM-2507, License for Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste, Amendment 4, August 2015. ML15212A805

4.12 Spent Fuel Project Office Interim Staff Guidance SFST-ISG-5, Revision 1, Confinement Evaluation.

4.13 Aging Effects for Structures and Structural Components (Structural Tools), EPRI Report 1015078, Revision 2.

4.14 American Concrete Institute, ACI 301, Specification for Structural Concrete of Buildings, 1989.

4.15 Non-Class 1 Mechanical Implementation Guideline and Mechanical Tools, EPRI Report 1010639, Revision 4.

4.16 EPRI Report No. 1003010, October 2001, Dry Cask Storage Characterization Project.

4.17 ASTM Standard C1562-10, Standard Guide for Evaluation of Materials Used in Extended Service of Interim Spent Nuclear Fuel Dry Storage System, ASTM International.

4.18 Spent Fuel Project Office Interim Staff Guidance SFST-ISG-11, Revision 3, Cladding Considerations for the Transportation and Storage of Spent Fuel, November 17, 2003, Nuclear Regulatory Commission.

4.19 ASTM C260, Standard Specification for Air-Entraining Admixtures for Concrete, American Society of Test and Measurement.

4.20 ASTM C494, Standard Specification for Chemical Admixtures for Concrete, American Society of Test and Measurement.

4.21 ASTM C33, Standard Specification for Concrete Aggregates, American Concrete Institute (ACI).

4.22 American Concrete Institute, ACI 349, Code Requirements for Nuclear Safety Related Concrete Structures, 1985.

4.23 NUREG-1801, Generic Aging Lessons Learned (GALL) Report, Rev. 2. ML103490041

4.24 NUREG/CR-6831, Examination of Spent PWR Fuel Rods after 15 Years in Dry Storage, 2003, Argonne National Laboratory. ML032731021

4.25 NUREG/CR-6673, Hydrogen Generation in TRU Waste Transportation Packages, UCRL-ID-13852, May 2000. ML003723404

4.26 Certified Test Report for Heat No. 7035, Lot ID 766-1, Laboratory Testing, Inc., Dublin, PA, September 30, 1999.

APPENDIX A

AGING MANAGEMENT PROGRAMS

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APPENDIX A: AGING MANAGEMENT PROGRAMS

A1.0 INTRODUCTION

This appendix summarizes the activities that manage the effects of aging for Independent Spent Fuel Storage Installation (ISFSI) subcomponents that have been identified in the North Anna ISFSI License Renewal Application (LRA) as being subject to aging management review. An Aging Management Program (AMP) has been developed for the ISFSI TN-32 dry storage cask, and a separate AMP has been developed for reinforced concrete pad No. 1. Section A2.1 and Section A2.2 provide a description of these AMPs, which includes an introduction to the AMP, an evaluation of the AMP in terms of the aging management program elements, a summary paragraph, and a conclusion.

The Aging Management Reviews (AMRs) in Section 3.0 provide tables that summarize the results of the AMRs. These tables identify the AMPs credited for managing the required aging effects for the applicable subcomponent and structural members listed in the AMR. The identified AMPs manage the aging effects applicable to the subcomponent, and provide reasonable assurance that the integrity of the subcomponent will be maintained during the period of extended operation.

A2.0 AGING MANAGEMENT PROGRAMS

A2.1 TN-32 Dry Storage Cask Aging Management Program

The purpose of the TN-32 Dry Storage Cask AMP is to define the aging management activities which are necessary to help ensure the integrity of the TN-32 dry storage cask. The AMR process identified loss of material from cask metallic and polymeric subcomponents as the aging effect of concern. The TN-32 Dry Storage Cask AMP ensures loss of material from the cask subcomponents will be identified and managed during the period of extended operation prior to loss of intended function. The TN-32 Dry Storage Cask AMP involves continuous monitoring of TN-32 dry storage cask interseal pressure, scheduled and opportunistic cask visual inspections and radiation monitoring at the ISFSI perimeter fence. An evaluation of the 10 program elements is presented below.

Element 1: Scope

The intended functions, materials, environments, aging mechanisms, and aging effects of the subcomponents in the scope of this program are identified in Table AMR Results-1, Transnuclear TN-32 Dry Storage Cask. The intended functions of the cask components include pressure boundary (PB), Radiation Shielding (RS), Heat Transfer (HT), Criticality Control (CC), Structural Support (SS), and Retrievability (RT). The aging effect monitored by this program is loss of material.

The mechanisms monitored or inspected by the TN-32 Dry Storage Cask AMP include:

- Galvanic, crevice and pitting corrosion of aluminum in an atmosphere/weather environment for the following components:
  - Lid seals
  - Vent and drain port cover seals
- Crevice and pitting corrosion of stainless steel in an atmosphere/weather environment for the following components:
  - Vent and drain port covers
  - Lid weld overlay
  - Flange weld overlay
- Radiolytic decomposition and thermal degradation of polypropylene and borated polyester in an air environment for the following components:
  - Top neutron shield
  - Radial neutron shield
- Galvanic, crevice, general, and pitting corrosion of carbon steel and low-alloy steel in an atmosphere/weather environment for the following components:
  - Cask shell
  - Lid
  - Lid bolts
  - Cask bottom
  - Trunnions
  - Outer shell
  - Top neutron shield enclosure
  - Top neutron shield bolts
  - Vent and drain port cover bolts
  - Flange

Element 2: Preventive Actions

This AMP is designated a *condition monitoring* activity. No preventive actions are performed.

Element 3: Parameters Monitored or Inspected

Interseal Pressure Monitoring

The interseal pressure of the TN-32 dry storage cask seals is continuously monitored by redundant pressure switches to verify the integrity of the TN-32 dry storage cask seals. Interseal pressure monitoring detects loss of material from the TN-32 dry storage cask seal subcomponents prior to loss of pressure boundary intended function. The interseal region is pressurized to help provide indication of cask seal integrity. A reduction of interseal pressure could indicate leakage due to loss of material that prevents the seal from performing its pressure-boundary function.

Radiation Monitoring

As described in Section 7.3.3 of the ISFSI SAR (Reference A4.1), TLDs located along the perimeter fence are used for monitoring of radiation dose at the North Anna ISFSI. TLDs are capable of detecting gamma, neutron, and beta radiation. Monitoring of gamma and neutron radiation ensures the shielding materials in the cask are capable of performing their intended function. Portable radiation survey meters are used for work on or near reinforced concrete pad No. 1. Airborne radioactivity monitoring is not required because the TN-32 dry storage casks are sealed. The ISFSI is not normally occupied; therefore, area radiation monitors are not required. The TN-32 dry storage casks are also decontaminated prior to transport to the ISFSI.

TLD radiation monitoring is supplemented by surveys performed during and following TN-32 dry storage cask loading, surveys performed prior to and during TN-32 dry storage cask maintenance activities, and quarterly gamma and neutron radiation surveys at the ISFSI perimeter fence.

Radiation monitoring is used to detect loss of material from shielding components prior to loss of radiation shielding intended function.

Visual Inspections

Quarterly visual inspections are performed to detect loss of material from TN-32 dry storage cask visible external surfaces exposed to an atmosphere/weather environment. Visual inspections will also be implemented to detect loss of material from the normally inaccessible exterior locations of the in-service TN-32 dry storage casks. Visual inspections of the dry storage cask bottom and beneath the protective cover will be required during the period of extended operation.

A pre-application inspection was performed in 2015. The inspection included lifting one TN-32 dry storage cask to verify the condition of a TN-32 dry storage cask bottom and removal of the protective cover from one TN-32 dry storage cask to verify the condition of the normally inaccessible subcomponents beneath the cover, e.g., neutron shield. The aging effect monitored was loss of material. No detectable loss of material from the base metal was observed during the inspection. Details of the pre-application inspection cask selection and inspection results are presented in Appendix F: Additional Information, Section F2.0.

Visual inspections look for signs of degradation on the exterior surfaces of cask components, as well as rust stains on reinforced concrete pad No. 1. The inspections also identify loose debris next to the cask that could result in a localized area of corrosion. Visual inspections detect loss of material from TN-32 dry storage cask subcomponents prior to loss of pressure boundary, structural support, radiation shielding, and heat transfer intended functions. Loss of material is indicated by localized general corrosion, erosion, or wear. Conditions such as fabrication marks, scratches, surface abrasion, or material roughness, which have no effect on intended functions, are considered non-relevant. The parameter monitored is consistent with those identified in industry codes and standards.

Element 4: Detection of Aging Effects

Detection of the TN-32 dry storage cask aging effect of loss of material relies on continuous interseal pressure monitoring, TLD radiation monitoring, and visual inspections (scheduled, opportunistic, and pre-application).

Interseal Pressure Monitoring

TN-32 dry storage cask interseal pressure is monitored continuously by redundant pressure switches at each TN-32 dry storage cask. Twice daily, the Operations Department verifies that no low pressure alarms are present, satisfying ISFSI Technical Specification Surveillance Requirement SR 3.1.4.1. (Reference A4.2). The aging effect monitored is loss of material.

A functional test of the pressure switches associated with each TN-32 dry storage cask is performed every 36 months to satisfy ISFSI Technical Specification Surveillance Requirement SR 3.1.4.2. This procedure verifies the TN-32 dry storage cask as-found interseal pressure, verifies the pressure switches actuate within the required range, and verifies the as-left interseal pressure.

An annual test of the TN-32 dry storage cask alarm panels is performed to ensure the ISFSI visual alarms on the dry storage cask alarm panels and the remote alarm in the Secondary Alarm Station respond to a test signal. This annual test also verifies alarms actuate on loss of power to the panels.

Excessive leakage past the TN-32 dry storage cask seals due to loss of material (corrosion) would actuate an alarm in the Secondary Alarm Station, which would initiate actions to verify seal integrity in accordance with approved procedures. Seal leakage is classified in accordance with the site Emergency Plan Implementing Procedures.

Discrepancies noted during the above monitoring activities are entered in the Dominion Corrective Action Program. The results of interseal pressure monitoring activities are maintained in Station Records.

Radiation Monitoring

Detection of gamma and neutron radiation is accomplished by placement of TLDs at the ISFSI perimeter fence. The TLDs are capable of detecting neutrons with energy levels up to approximately 6 MeV, which represent 98 percent of the neutron population in the TN-32 dry storage cask prior to neutron moderation. While TLDs may not be capable of detecting all neutrons, they are effective in detecting adverse trends in neutron dose at the ISFSI perimeter fence.

TLD readings are obtained quarterly and recorded in approved Health Physics procedures. Results from this monitoring activity provide a means to detect deterioration of the TN-32 dry storage cask gamma and neutron shield. The quarterly monitoring of TLD readings is used as an indicator that loss of material from the radiation shield is detected prior to a loss of intended function.

TLD radiation monitoring is supplemented by surveys performed during and following cask loading, surveys performed prior to and during cask maintenance activities, and quarterly surveys at the ISFSI perimeter fence. Calibration of survey instruments is verified prior to use.

Discrepancies noted during the above monitoring activities are entered into the Dominion Corrective Action Program. The monitoring results are maintained in Station Records.

ISFSI Technical Specification Limiting Condition for Operation 3.3.1 places limits on the maximum combined gamma and neutron dose rate at the sides and top of the TN-32 dry storage cask prior to transporting the dry storage cask to reinforced concrete pad No. 1 (Reference A4.2). These limits ensure that the dry storage cask average surface dose rates during transport, storage, and dry storage cask unloading are within the estimates contained in the ISFSI Safety Analysis Report (Reference A4.1).

Visual Inspections

Visual inspections identify loss of material on the external surfaces of the TN-32 dry storage cask subcomponents prior to loss of intended function. Quarterly visual inspections, performed by the system engineer are general inspections that are performed consistently with requirements for plant walkdowns to identify signs of coating defects, debris in the vicinity of the TN-32 dry storage casks, rust spots and stains, rust stains on reinforced concrete pad No. 1, physical damage, and bottom corrosion at the concrete/TN-32 dry storage cask interface. Quarterly inspection results have identified coating deficiencies but no visible loss of base material. Non-destructive examination (NDE) qualification is not required to perform the quarterly inspection.

The following carbon steel and low-alloy steel subcomponents requiring aging management are exposed to an atmosphere/weather environment and are either fully or partially observable during the quarterly visual inspection:

- Cask Shell
- Outer Shell
- Trunnions
- Flange

The following carbon steel and/or low-alloy steel dry storage cask subcomponents requiring aging management are exposed to an atmosphere/weather environment, but are not visible during the quarterly inspection:

- Lid
- Cask Bottom
- Top Neutron Shield Enclosure
- Top Neutron Shield Bolts
- Lid Bolts
- Vent and Drain Port Cover Bolts

No stainless steel subcomponents requiring aging management are visible during the quarterly inspection.

Inspection activities will be expanded to include opportunistic and scheduled NDE inspections of a TN-32 dry storage cask bottom and the subcomponents beneath a protective cover. Visual inspection of the flange stainless steel weld overlay and carbon and low-alloy steel subcomponents serve as a leading indicator for stainless, carbon, and low-alloy steel subcomponents requiring aging management, but not visible during the opportunistic and scheduled inspections, e.g., vent and drain port covers and bolts.

In the event a TN-32 dry storage cask is lifted, or a protective cover is removed, an opportunistic visual inspection will be performed on these normally inaccessible locations. A scheduled visual inspection of these locations will be performed on a frequency of every 20 ± 5 years. The selection criteria for the 20-year scheduled inspection will be the same as the criteria used to select the casks for the pre-application inspection (Refer to Section F2.1). The pre-application inspections did not identify loss of material from the base metal on the bottom of cask TN-32.49 or beneath the protective cover of cask TN-32.23 (Refer to Section F2.2). North Anna is located in a rural part of Virginia on a freshwater lake and is not located near industrial or chemical facilities. The TN-32 dry storage casks are not exposed to brackish water, saltwater spray, or high-sulfur emissions. An inspection frequency of 20 ± 5 years is therefore acceptable to detect loss of material prior to loss of intended function. The sample size of one cask is consistent with prior license renewal applications approved by the NRC.

Dominion has chosen to utilize standard industry visual inspection techniques in accordance with NUREG-1927 (Reference A4.3). Opportunistic and 20-year scheduled TN-32 dry storage cask visual inspections will be performed by personnel qualified to perform visual inspections, i.e., VT-1 and VT-3. VT-1 and VT-3 examinations are performed per Dominion NDE Fleet procedures. VT-1 inspections are utilized for specific components/subassembly inspections and VT-3 inspections are utilized for general assembly inspections. In general, the inspection requirements of the VT-1 examination are more stringent than that of the VT-3 examination. For example, the maximum examination distance for a VT-1 examination is less than that allowed for a VT-3 examination. Refer to Section XI, Subarticle IWA-2210 of the ASME Boiler and Pressure Vessel Code for additional information on visual examination techniques.

The specific visual inspection methods that will be used for opportunistic and 20-year scheduled inspections of the TN-32 dry storage casks are as follows:

- Protective cover and subassembly interior/exterior surfaces (VT-3)
- Cask flange visible surfaces (VT-1)
- Overpressure system visible surfaces (VT-3)
- Neutron shield visible surfaces (VT-3)
- Cask lid visible surfaces and lid bolt heads (VT-3)
- Neutron shield bolts (VT-1 and/or VT-3)
- Protective cover bolts (VT-1 and/or VT-3)
- Upper and lower trunnions (VT-3)
- Cask bottom surface (VT-3)

The neutron shield and protective cover bolts inspection technique will be either a VT-1 or VT-3 examination depending upon whether the bolt is installed (VT-3) or if the bolt is removed for detailed examination (VT-1).

A pre-application visual inspection was also performed in Fall 2015. VT-1 and VT-3 examination methods were utilized during the inspection. Details of the TN-32 pre-application inspection are contained in Appendix F: Additional Information, Section F2.0.

Discrepancies noted during the above inspections are entered in the Dominion Corrective Action Program. The results of visual inspection activities are maintained in station records. The visual inspection activities ensure loss of material is detected in TN-32 dry storage cask subcomponents prior to loss of intended function.

Element 5: Monitoring and Trending

The inspections and monitoring activities in this AMP are all performed periodically in order to identify areas of degradation. Results will be evaluated by qualified individuals consistent with industry guidelines, standards and regulations. Conditions adverse to quality noted during the inspection and monitoring activities, such as non-conformances, failures, malfunctions, deficiencies, deviations, or defective material and equipment are entered into the Dominion Corrective Action Program. Depending on significance, a more focused evaluation may be required to determine the extent of condition and determine if more frequent monitoring or inspection is required. As discussed below, visual inspections and radiation monitoring assessments appropriately consider cumulative experience from previous inspections and assessments in order to monitor and trend the progression of aging effects over time. Additionally, the Dominion Corrective Action Program includes trending of adverse conditions (including those related to interseal pressure monitoring, radiation monitoring, and visual inspections) as well as a process to prevent recurrence.

An enhancement will be made to perform an engineering evaluation every five years to review industry and plant-specific operating experience (including work order history). The evaluation will also review previous inspection results to determine if any adverse trends are identified warranting additional corrective actions to manage the loss of material for the TN-32 dry storage casks. Each element of the TN-32 Dry Storage Cask Aging Management Program will be reviewed to determine if updates are required based on lessons learned from the operating experience review.

Interseal Pressure Monitoring

Pressure monitoring of each TN-32 dry storage cask at the ISFSI is a continuous process. The absence of low pressure alarms is confirmed twice daily by the Operations Department. The functionality of the pressure switches is confirmed every 36 months. Pressure switches that do not meet established acceptance criteria are entered in the Dominion Corrective Action Program. Corrective actions include adjustment or replacement as well as review for extent of condition.

Radiation Monitoring

As previously described, both TLD readings and radiation survey readings taken at the ISFSI perimeter fence are evaluated quarterly. Table A2.1-1, ISFSI Historical Neutron Dose Rates (2006 through 2015) and Table A2.1-2, ISFSI Historical Gamma Dose Rates (2006 through 2015) provide the maximum and minimum historical neutron and gamma quarterly dose rates at the ISFSI perimeter fence from first quarter 2006 through fourth quarter 2015. Dose rates were determined by dividing the quarterly TLD dose by the number of exposure hours in the quarter.

Table A2.1-1 ISFSI Historical Neutron Dose Rates (2006 through 2015)

North Dose Rate (microrem/hr)		East Dose Rate (microrem/hr)		South Dose Rate (microrem/hr)		West Dose Rate (microrem/hr)	
Max	Min	Max	Min	Max	Min	Max	Min
118	35	64	18	157	43	96	26

Table A2.1-2 ISFSI Historical Gamma Dose Rates (2006 through 2015)

North Dose Rate (microrem/hr)		East Dose Rate (microrem/hr)		South Dose Rate (microrem/hr)		West Dose Rate (microrem/hr)	
Max	Min	Max	Min	Max	Min	Max	Min
16	5	18	4	26	11	24	10

The review of historical dose rates at the ISFSI perimeter fence shows no evidence that the neutron and/or gamma shielding is degrading. Notwithstanding, an enhancement will be implemented to perform an annual evaluation of ISFSI perimeter fence radiation measurements for adverse trends to ensure that deterioration of the TN-32 dry storage casks gamma and neutron shield material is detected prior to loss of intended function. Based on the review of 10 years of ISFSI boundary dose rates, quarterly recording and annual trending of dose rates at the ISFSI perimeter fence is adequate to detect a loss of shielding material prior to loss of intended function.

Quarterly radiation surveys at the ISFSI perimeter fence and surveys associated with TN-32 dry storage cask loading and maintenance are performed to supplement the overall radiation monitoring program.

Visual Inspections

Quarterly visual inspections determine the existence of loss of material in the TN-32 dry storage cask exterior regions and check for accumulation of debris and concrete staining. Observations regarding the material condition of the TN-32 dry storage casks external surfaces are recorded per the inspection procedure. 20-year scheduled and opportunistic visual inspections of normally inaccessible areas will be included in the aging management program in addition to the quarterly visual inspections.

As described in Element 4: Detection of Aging Effects, an enhancement will be made to perform a visual inspection of the normally inaccessible areas of a TN-32 dry storage cask(s) including a cask bottom and under a protective cover at least every 20 ± 5 years. Prior inspection results (including pre-application inspection results) will be reviewed to identify adverse trends. The pre-application inspections (refer to Element 10: Operating Experience) did not identify any detectable loss of material from the bottom of cask TN-32.49 or under the protective cover of cask TN-32.23. North Anna is located in a rural area of Virginia on a freshwater lake and is not located near industrial or chemical facilities. The TN-32 dry storage casks are not exposed to brackish water, saltwater spray, or high-sulfur emissions. An inspection frequency of every 20 ± 5 years is adequate to detect loss of material prior to loss of an intended function.

Element 6: Acceptance Criteria

The TN-32 Dry Storage Cask Aging Management Program acceptance criteria ensure that the particular structure and component intended functions are maintained under the existing licensing-basis design conditions during the period of extended operation.

Interseal Pressure Monitoring

The acceptance criterion for interseal pressure monitoring is the absence of a low pressure alarm. The alarm setpoint of 3,250 mbar is specified in ISFSI Technical Specifications Table 3-1 (Reference A4.2). Dominion procedures document the required setpoint tolerance. A Condition Report is entered into the Corrective Action Program for any pressure switch that actuates at less than the required setpoint or outside of the required tolerance.

Radiation Monitoring

The aging management program will be enhanced to include annual trending of TLD neutron and gamma radiation measurements at the ISFSI perimeter fence. The acceptance criterion for radiation monitoring is the absence of an increasing trend (as determined by Engineering evaluation) in neutron and gamma quarterly TLD readings at the ISFSI perimeter fence.

Visual Inspections

The acceptance criteria for the quarterly visual inspections are:

- No coating defects (bubbling/blistering of paint)
- No loose debris in contact with the cask(s)
- No rust spots and stains
- No rust stains on the concrete
- No physical damage
- No baseplate corrosion at the concrete/cask interface

The acceptance criterion for the opportunistic and scheduled inspections of the TN-32 dry storage cask will be no detectable loss of material from the base metal as determined by VT-1 and/or VT-3 visual inspection.

Indications adverse to quality identified during the above inspection and monitoring activities, e.g., flaking of TN-32 dry storage cask coating, are entered into the Dominion Corrective Action Program for further evaluation. This low corrective action threshold ensures all conditions adverse to quality are captured and evaluated. If required, the engineering evaluation would include support by qualified Non-Destructive Examination staff to perform additional inspections to assess the extent of condition.

Element 7: Corrective Actions

Corrective actions for deviating conditions that are adverse to quality, e.g., failures, malfunctions, deficiencies, deviations, defective material and equipment, and non-conformances, are performed in accordance with Dominion Topical Report DOM-QA-1, "Nuclear Facility Quality Assurance Program Description" (Reference A4.4). Adherence to DOM-QA-1 ensures that, as required by 10 CFR 50, Appendix B, an adequate quality assurance program is implemented.

The Dominion Corrective Action Program is implemented in accordance with a nuclear fleet administrative procedure. The administrative procedure includes expectations for identification and reporting of conditions adverse to quality, conditions that affect personnel safety, nuclear safety, plant reliability, trending, and other conditions that do not meet station expectations. For conditions determined to be significantly adverse to quality the procedure provides measures to provide reasonable assurance that the cause of the condition is determined, corrective action is taken in a timely and accurate manner to preclude repetition, and the cause and corrective actions taken are documented and reported to appropriate levels of management. A condition significantly adverse to quality is defined as a condition adverse to quality that has, or if left uncorrected could have, an undesirable effect on plant safety, regulatory position, or environmental impact.

Station deficiencies are identified by the submission of condition reports (CRs). An attachment to the administrative procedure provides a detailed list of examples of conditions that require submission of a CR. At a minimum, CRs are submitted for any issue or concern that does not meet specific requirements of procedures, policies, management expectations, or accepted industry standards including all conditions that do not meet the AMP acceptance criteria. CRs are also required to be submitted for any issue where there is doubt about whether a CR should be submitted. The procedure also provides guidance for submittal of CRs anonymously.

Submitted CRs are initially reviewed by the submitters' supervisor. The supervisor answers screening questions to determine if Operations Shift Manager review is required. If so, the shift manager, or designee, performs an operability assessment. As required by 10 CFR 72.75, reportability determinations are also made. Further review of the CR is then performed by the Condition Report Review Team (CRT).

The CRT is a multi-discipline, multi-departmental team consisting of members from Engineering, Maintenance, Operations, Radiation Protection, Training, and Organizational Effectiveness. At least one member of the CRT should have, or previously held, a Senior Reactor Operators license. Functions of the CRT include:

- Identifying conditions that are adverse to quality
- Establishing corrective action assignments
- Assigning required significance level and level of evaluation to CRs (e.g., Root Cause Evaluation)
- Reviewing CRs for trending and notifying the Trend Coordinator for submission of an additional CR to address trending aspects
- Reviewing CRs for safety implications
- Reviewing CRs for initiation of work management activities
- Recommending compensatory measures
- Identifying events that should be communicated to the industry via the INPO Consolidated Event System
- Notifying senior management of significant events

CRs identified as adverse to quality by the CRT are further reviewed by the Corrective Action Assignment Review Team (CAART). The CAART is generally comprised of senior-level management, Manager level and above, and includes the Plant Manager. The CAART reviews the results and recommendations of the CRT and has the authority to make changes when appropriate. The CAART also identifies selected issues to be reviewed by the Facility Safety Review Committee.

The response to corrective action assignments is reviewed to verify the adequacy of the response and proposed corrective actions, including no corrective action. CRT or CAART may assign additional reviews when appropriate.

A self-assessment is performed at least every two years to determine the effectiveness of the Corrective Action Program. An aggregate review of all open conditions designated as adverse to quality is performed at least every eighteen months to ensure appropriate priorities have been assigned to these outstanding issues.

Element 8: Confirmation Process

Adherence to the Dominion Quality Assurance Program ensures that, as required by 10 CFR Part 50, Appendix B, an adequate quality assurance program is implemented. The Quality Assurance program includes provisions for timely evaluation of adverse conditions, and implementation of any corrective actions required, including root cause evaluations and actions to prevent recurrence. Procedural controls are in place to ensure the response to corrective action assignments is reviewed to verify the adequacy of the response and the corrective actions. Condition reports are also reviewed for trending purposes.

An engineering evaluation will be performed every five years to review industry and plant-specific operating experience (including work order history). Each element of the aging management program will be reviewed to determine whether updates to the program are required based on lessons learned from the operating experience review. The evaluation will also review previous inspection results to determine if any adverse trends are identified warranting additional corrective actions to manage loss of material from the TN-32 dry storage casks.

Element 9: Administrative Controls

All activities associated with the North Anna ISFSI that are important to safety are conducted in accordance with Dominion Topical Report DOM-QA-1, "Nuclear Facility Quality Assurance Program Description" (Reference A4.4). Adherence to DOM-QA-1 ensures that, as required by 10 CFR 50, Appendix B, an adequate quality assurance program is implemented. DOM-QA-1 includes guidance for inspector requirements, record retention requirements, and document control. Administrative and technical procedures are reviewed, approved, and maintained as controlled documents in accordance with the Dominion procedure control process and the Quality Assurance Program. Administrative controls have been established to ensure records are identified, retained, maintained, and retrievable. Approved procedures define record retention requirements and storage methods.

Element 10: Operating Experience

The Dominion operating experience (OE) program is implemented in accordance with an administrative procedure. The goal of the OE Program is to effectively and efficiently use lessons learned from the industry to improve safety and reliability and to reduce the number and consequence of events. The procedure includes applicability screening of OE reports from the NRC, INPO, and vendors. Guidelines for use of the INPO Nuclear Network Forums are included in the procedure. The procedure also stipulates OE coordinator trending reviews at set frequencies and OE coordinator qualification requirements.

As stated in Element 8: Confirmation Process, additional reviews occur during the engineering evaluation of industry and plant-specific operating experience that will occur every five years to determine whether updates to the aging management program are needed to address lessons learned. The historical absence of significantly adverse findings for the ISFSI confirms that a review interval of five years is sufficient to address the potential need for any changes to the aging management programs.

A separate administrative procedure provides instruction for submitting Dominion OE to the INPO Consolidated Event System (ICES). The purpose of this procedure is to provide a method for identification and reporting of INPO ICES reports. The procedure includes reporting criteria and required reporting time frames.

Key word searches were performed of the Dominion Corrective Action Program and the INPO OE database to ensure the aging effects of concern are accurately identified and lessons learned are reviewed for applicability to NAPS. The OE searches included a review of industry and North Anna and Surry-specific OE. The INPO OE database includes international and NRC related information. Transnuclear vendor bulletins were also reviewed. The review of the Dominion Corrective Action Program utilized the following search terms:

- Cask
- ISFSI
- TN-
- Transnuclear

The review of the INPO OE database utilized the following search terms:

- ISFSI
- Dry Storage
- Dry Cask
- Transnuclear

Table A2.1-3, North Anna ISFSI Aging-related Operating Experience, provides a listing of North Anna-specific OE directly related to aging of SSCs in the scope of license renewal and a brief summary of the corrective actions taken. The events can be categorized into TN-32 dry storage cask coating deficiencies and dry storage cask low pressure alarms, the most significant being low pressure alarms. Further discussion of these events is provided later in this section.

Table A2.1-3 North Anna ISFSI Aging-related Operating Experience

Date	Report	Title	Description/Corrective Actions
06/18/00	N-2000-1551	Crack in TN-32.06 Cask Coating	The coating was repaired in accordance with the manufacturer's instructions.
02/01/10	CR367334	TN-32.48 Pressure Alarm Response	Following a low pressure alarm, troubleshooting revealed the overpressure system (OP) pressure was less than the alarm setpoint but greater than the Technical Specification minimum required value. The OP system pressure was returned to normal. Helium leaks checks did not identify leakage from the OP System. Engineering recommended OP system pressure be checked during the performance of the scheduled pressure switch test the following month. OP system pressure and alarm setpoints were verified to be normal on March 9, 2010. No further actions were required. The OE review did not identify any additional low pressure alarms for dry storage cask TN-32.48. It was also noted during troubleshooting that one of the two pressure switches failed to alarm. This pressure switch was replaced.
8/29/2011	CR440206	ISFSI Pad 1 TN-32 Paint	During a walkdown following the seismic event of 8/23/2011, a concern was identified that the dry storage cask bottom coating may have been scratched due to movement of the dry storage casks. Transnuclear provided a response stating that no repair of the coating was required. The quarterly visual inspection procedure was revised to include inspection for bubbled/blistering paint and corrosion product stains on reinforced concrete pad No. 1 near the dry storage cask bottom. (Note: The results of the pre-application inspection performed in 2015 did identify deterioration of the bottom protective coating, but no detectable loss of material from the dry storage cask base metal.)
01/24/13	CR503456	Documentation of 0-PT-4.3 results	Rust stains resulting from coating defects (e.g., flaking) were noted on several dry storage casks and reinforced concrete pad No. 1 adjacent to the dry storage casks. It was concluded since these conditions are superficial that immediate action was not required. A work order was written to remove rust stains from concrete and TN-32 dry storage casks.

Table A2.1-3 North Anna ISFSI Aging-related Operating Experience

Date	Report	Title	Description/Corrective Actions
01/13/14	CR536973	Documentation of 0-PT-4.3 results	Items noted on this inspection were previously identified in CR503456. A comparison of pictures taken on 5/2/13 did not indicate further degradation had occurred. No further action was required other than continued monitoring during the quarterly visual inspections.
07/14/14	CR553872	Coating deficiencies found during 0-PT-4.3	Superficial coating defects, e.g., scratches, paint flaking, etc., were noted on three dry storage casks with no base metal exposed.
09/21/15	CR1010377	Cask TN-32-32 Over Pressure System Low Pressure Alarm	Initial troubleshooting of the cask low pressure alarm confirmed proper operation of the pressure switches and did not identify helium leakage from the overpressure system. Engineering established dry storage cask pressure monitoring frequency of once per month. Monitoring results were provided to Engineering for trending.
10/03/15	CR1012049	TN-32.37 low pressure switch alarm	Investigation revealed a face seal on a pressure switch was leaking. The seal was replaced and overpressure system pressure was restored to normal pressure.
10/14/15	CR1013461	ISFSI License Renewal, Bottom of Cask TN-32.49 Inspection Results	This condition report was written to document the completion of the pre-application cask bottom inspection. Engineering evaluation of results concluded that no corrective actions were required. Refer to Section F2.2.
11/18/15	CR1018794	TN-32.23 Cask Inspection results	This condition report was written to document the completion of the pre-application cask top inspection. Engineering evaluation of the results concluded that no corrective actions were required. Refer to Section F2.2.

As part of the OE review, recent license renewal applications submitted by Prairie Island Nuclear Generating Station and Calvert Cliffs Nuclear Power Plant were reviewed. The review confirmed the aging effects identified, associated examination techniques, and acceptance criteria are consistent with the industry.

The EPRI Dry Cask Storage Characterization Project documents an aging study of a Castor V/21 dry storage cask after approximately 15 years of dry storage. The project identified corrosion of stainless steel fasteners used to attach the V/21 dry storage cask rear breech plate, i.e., dry storage cask bottom. North Anna does not use Castor V/21 dry storage casks. Fuel rods from the Castor V/21 dry storage cask having a burnup of 35.7 GWD/MTU were removed and studied by Argonne National Laboratory (ANL). No detrimental aging of the low burnup fuel rods was identified.

Several technical data gaps have been identified related to the aging effects of V/21 dry storage casks and spent fuel, e.g., cladding hydride reorientation and embrittlement. The U.S. Department of Energy Office of Nuclear Energy developed the Gap Analysis to Support Extended Storage of Used Nuclear Fuel report to identify and prioritize the data gaps. This report was reviewed to ensure all technical data gaps were identified and prioritized correctly and to compare the gaps with those identified in similar reports from various agencies, including international studies. It was recommended that low burnup fuel from the Castor V/21 dry storage cask initially inspected by ANL be reexamined to better understand the long-term aging of low burnup fuel. It was noted that the fuel initially examined by ANL was loaded into a dry cask as opposed to one that experienced the prototypical drying cycle. The examined fuel, therefore, was not exposed to the residual moisture that may be present in a typical dry storage cask such as those in use at North Anna.

As identified in Section A3.0, Summary, Dominion has committed to reviewing industry operating experience to ensure the aging effects, inspection techniques, inspection frequencies, and acceptance criteria are consistent with the most recent industry standards and practices. The resolution of the technical data gaps described above will be included in the operating experience review.

Interseal Pressure Monitoring Operating Experience

A review of operating experience related to the TN-32 dry storage cask interseal pressure monitoring revealed no aging-related issues with the metallic O-ring seals on TN-32 dry storage casks. Refer to Table A2.1-3, North Anna ISFSI Aging-related Operating Experience for a list of condition reports and associated corrective actions for North Anna.

Based on industry and site-specific OE review, actuation of TN-32 dry storage cask low pressure alarms is not unexpected. North Anna has not experienced failure of the primary cask seal, which could result in leakage of radioactive materials to the outside atmosphere.

The alarms are generally the result of helium leakage from fittings on the overpressure system, low ambient temperature, or failed pressure switches. North Anna has developed a troubleshooting procedure for TN-32 dry storage cask low pressure alarms. The procedure includes troubleshooting cask pressure switches and checking the overpressure system for leakage.

In 1999 and 2000, low interseal pressure alarms occurred on five TN-32 dry storage casks in place at Surry Power Station. The five TN-32 dry storage casks were returned to the spent fuel pool and unloaded in order to examine the inner and outer seals. Inspection of the seals showed no evidence of corrosion of the inner seal; but the outer seal was observed to be corroded. Corrosion of the lid bolt heads was also identified during the inspection. The evaluation concluded the low pressure alarms were the result of corrosion from water intrusion inside the protective cover due to improper assembly of the Conax connector penetrating the apex of the protective cover. The introduction of water inside the cover resulted in galvanic corrosion of the aluminum covered outer seal in contact with the stainless steel weld overlay on the dry storage cask flange and lid. The loss of material due to galvanic corrosion of the aluminum outer metallic seal cover was sufficient to actuate the low pressure alarms. The metallurgical report also identified chlorine in the corrosion deposits, which most likely resulted from the surrounding atmospheric environment at Surry Power Station. A similar issue occurred in 2011 on a Transnuclear dry storage cask at Peach Bottom Atomic Power Station.

Corrective actions to prevent recurrence at Surry and North Anna Power Stations included use of silver-coated O-rings with silver-coated seals on all future casks. Additionally, the covers were modified on all casks to remove the Conax connector and install an access plate (referred to as the Subassembly) in the cover, which is bolted and sealed. Desiccant was also placed on top of the neutron shield to minimize moisture. Following these corrective actions, there has been no recurrence of water intrusion inside the protective covers.

In addition to corrosion of the outer lid seal, a second issue was identified when the TN-32 dry storage casks were returned to the spent fuel pool. The torque value applied to the lid bolts was determined to be less than the original specified torque value. Ten lid bolts on one TN-32 dry storage cask and three lid bolts on another TN-32 dry storage cask could be moved by hand. Although the torque was less than specified, cask containment integrity was maintained and no leakage to the environment resulted. It was concluded that the loss of bolt pre-load was the result of applying final lid bolt torque before the TN-32 dry storage cask achieved thermal equilibrium, and not the result of age-related loss of pre-load. In April 2001, Transnuclear issued an Information Bulletin to inform the industry of the above issues. The bulletin recommended final lid bolt torque be applied to the lid bolts after the TN-32 dry storage cask reaches thermal equilibrium.

Transnuclear also recommended use of Neolube or Loc-Tite N-5000 as the preferred lubricant for lid bolts. The bulletin recommendations have been implemented at NAPS, including the use of N-5000 lubricant.

There have been instances in the industry and at North Anna and Surry Power Stations where low pressure alarms have occurred as a result of non age-related conditions. These include alarms resulting from conditions such as leakage in the overpressure system, low atmospheric temperature, pressure switch setpoint drift, and pressure switch failure.

Radiation Monitoring Operating Experience

The review of site-specific and industry operating experience, as well as historical dose rates recorded at the ISFSI perimeter fence shows no evidence that the neutron and/or gamma shielding is degrading. An enhancement will be implemented to perform an annual evaluation of ISFSI perimeter radiation measurements for adverse trends to ensure that deterioration of the TN-32 dry storage casks shielding materials is detected prior to loss of intended function.

Visual Inspections Operating Experience

The North Anna ISFSI has been in operation for more than 17 years. A review of all previously completed quarterly inspections, as well as the Dominion Corrective Action Program, identified cases of minor coating degradation, i.e., no visible loss of base material, and rust stains on reinforced concrete pad No. 1. A separate aging management program has been developed to monitor the condition of reinforced concrete pad No. 1. TN-32 dry storage cask coating deficiencies are expected to occur over time. None of the previously identified coating deficiencies have challenged the intended functions of the cask subcomponents. As station resources permit, coating defects are corrected by removal of the existing coating and re-application of the coating. As of March 2016, nine TN-32 dry storage casks have been re-coated. Refer to Table A2.1-3, North Anna ISFSI Aging-related Operating Experience for a list of condition reports and associated corrective actions related to visual inspections.

August 2011 Seismic Event

On August 23, 2011, NAPS experienced a moment magnitude (M) 5.8 earthquake that was centered approximately 11 miles from the plant. The plant's seismic design basis was exceeded and Units 1 and 2 were shutdown without incident.

A walkdown of the ISFSI was performed on August 24, 2011. It was discovered that 25 of the 27 TN-32 dry storage casks had shifted from their original locations. Table F2-1 identifies the resulting movement of each cask. On August 29, 2011, a team consisting of personnel from Transnuclear Structural Analysis and Civil Construction groups as well as Dominion Nuclear Spent Fuel engineers performed a walkdown of the ISFSI.

Although 25 of the 27 TN-32 dry storage casks had shifted, there were no indications of damage to the TN-32 dry storage casks or the fuel inside the casks. After an M 3.4 aftershock, a follow-up inspection was performed on September 1, 2011 and included the following inspections/observations:

- Above-ground pressure monitoring systems including the remote monitoring panel were visually inspected and no damage was found. No pressure monitoring system alarms were received during the event. Electrical power at the ISFSI was not lost during the seismic event.
- Visual inspection of reinforced concrete pad No. 1 did not reveal any cracking or damage from the seismic event.
- Radiological surveys of the TN-32 dry storage casks did not indicate an increase in cask surface dose rates when compared to the dose rates obtained following cask loading.
- On August 30, 2011, inspections were performed on six randomly selected pressure switches. These inspections concluded that setpoints had not drifted outside of what would normally be expected and Helium pressure was consistent with expectations.

An Operability Determination concluded that the TN-32 dry storage casks were operable and performing as designed. To ensure a greater confidence that the TN-32 dry storage casks were not affected by the seismic event, Dominion performed the following detailed inspections on five TN-32 dry storage casks based on recommendations from Transnuclear:

- The tubing and valves connected to the NEMA box for evidence of cracking or deformation
- The protective cover subassembly for deformation or cracking
- The protective cover for evidence of moisture leakage
- The lower edge of the lid near the outer O-ring for evidence of moisture
- The overpressure tank mounting brackets for evidence of bending or loosening
- The top of the neutron shield for damage due to overpressure tank mounting brackets deformation
- The neutron shield bolts for damage
- The top of the neutron shield for damage
- The tubing and valves connected to the overpressure tank for evidence of cracking or deformation
- The protective cover bolts for evidence of bending or loosening

The inspections identified water intrusion and rust inside the NEMA electrical box associated with dry storage cask TN-32.36. The scope of the NEMA box inspections was expanded to inspect all remaining TN-32 dry storage casks to determine the extent of condition.

Water intrusion in three additional NEMA boxes was identified. Condition reports were initiated to document the deviating conditions. Work orders were initiated and repairs made to the NEMA boxes.

Pre-application Inspection

A pre-application inspection was performed at NAPS in Fall 2015 to evaluate the condition of the TN-32 dry storage casks. See Appendix F: Additional Information, Section F2.0, for the results of the pre-application inspection and the basis for cask selection.

Summary of Enhancements

The following enhancements will be made to the TN-32 Dry Storage Cask Aging Management Program:

1. Perform an engineering evaluation every 5 years to review industry and plant-specific operating experience (including work order history). The evaluation will also review previous inspection results to determine if any adverse trends are identified warranting additional corrective actions to manage the loss of material for the TN-32 dry storage casks. Each element of the TN-32 Dry Storage Cask Aging Management Program will be reviewed to determine if updates are required based on lessons learned from the OE review.
2. Perform an opportunistic visual inspection of a TN-32 dry storage cask bottom and under the protective cover in the event a dry storage cask is lifted or a protective cover is removed. The acceptance criterion is no detectable loss of material from the base metal as determined by VT-1 and/or VT-3 inspection.
3. Perform a visual inspection of a TN-32 dry storage cask bottom and under the protective cover at least every 20 ± 5 years. The selection criteria for the 20-year scheduled inspection will be the same as the criteria used to select the cask for the pre-application inspection. The 5-year periodic reviews of operating experience, as well as changes to the aging management program resulting from the review, will be considered in cask selection. The acceptance criterion is no detectable loss of material from the base metal as determined by VT-1 and/or VT-3 inspection.
4. Perform an annual evaluation of neutron and gamma quarterly TLD readings to confirm the absence of an increasing trend (as determined by engineering evaluation).

Conclusion

Based on the operating experience review and pre-application inspection results, the TN-32 dry storage cask intended functions have not been challenged by age-related degradation. Existing procedures, along with proposed enhancements, provide reasonable assurance that the intended functions will be maintained consistent with the ISFSI design basis during the period of extended operation.

A2.2 Monitoring of Structures Aging Management Program

The purpose of Monitoring of Structures Aging Management Program (AMP) is to define the aging management activities which are necessary to help ensure the integrity of reinforced concrete pad No. 1 for storage of TN-32 dry storage casks. Reinforced concrete pad No. 1 on which the TN-32 dry storage casks rest is an above-ground, outdoor installation which is capable of withstanding the anticipated effects of "weathering." The aging management review process identified cracking, change in material properties, and loss of material as the aging effects of concern. The Monitoring of Structures Aging Management Program ensures cracking, change in material properties, and loss of material from reinforced concrete pad No. 1 will be identified and managed during the period of extended operation prior to loss of intended function. The program includes visual inspections to manage the above-grade aging effects and groundwater chemistry monitoring to identify below-grade aging mechanisms. The reinforced concrete pad No. 1 is not located in groundwater; however, a groundwater chemistry program will be established to provide supplemental information for identifying conditions conducive to underground aging mechanisms. An evaluation of the 10 program elements is presented below.

Element 1: Scope

The Monitoring of Structures Aging Management Program manages the effects of aging for the North Anna ISFSI reinforced concrete pad No. 1, which is exposed to atmosphere/weather and soil. Reinforced concrete pad No. 1 has an intended function of maintaining structural integrity to provide uniform and substantial support for the TN-32 dry storage casks, and to ensure that decelerations experienced during design accidents are acceptable.

The applicable aging mechanisms and aging effects for reinforced concrete pad No. 1 are:

Aging Mechanism	Aging Effect(s)
Reaction with aggregates	Cracking
Freeze-thaw	Cracking
	Loss of material
Leaching of calcium hydroxide	Change in material properties
Settlement	Cracking

Element 2: Preventive Actions

The Monitoring of Structures Aging Management Program is designated a *condition monitoring* activity. No preventive actions are performed.

Element 3: Parameters Monitored or Inspected

This AMP describes periodic visual monitoring, which is performed to determine the surface condition of reinforced concrete pad No. 1. The surface condition is a leading indicator for the overall integrity of the pad. Visual inspections detect surface defects resulting from the aging mechanisms of reaction with aggregates (e.g., alkali-silica reaction), freeze-thaw, leaching of calcium hydroxide, or settlement. Surface indications of age-related degradation for reinforced concrete pad No. 1 include loss of material, cracking, and white stains, indicative of leaching (change in material properties).

An opportunistic inspection of the normally inaccessible area of reinforced concrete pad No. 1 under the TN-32 dry storage cask will be performed whenever a cask is lifted. An opportunistic inspection will also be performed for the inaccessible below-grade portions of the concrete pad if made available by excavation during the course of other work.

Supplemental information will be obtained from groundwater samples to be taken at the ISFSI site and analysis of the water chemistry will determine values for chlorides, sulfates, and pH at two groundwater wells every five years. This information will be utilized in identifying conditions conducive to underground aging mechanism due to an aggressive chemical environment. Measured values which exceed established acceptance criteria for these three parameters indicate a condition that could be detrimental for concrete in contact with the groundwater. However, reinforced concrete pad No.1 is not exposed to groundwater in the soil environment.

Element 4: Detection of Aging Effects

Visual inspections identify degradation of the physical condition due to aging effects on the surfaces for reinforced concrete pad No. 1 such that there is no loss of intended function. These visual inspections check for irregularities such as cracking, loss of material on the concrete surface, and effects from change in material properties (due to leaching). The inspections will be performed in accordance with a new procedure for structural monitoring of reinforced concrete pad No. 1. Qualification requirements for the person performing the inspection of reinforced concrete pad No. 1, and for the engineer evaluating the inspection results, shall comply with the requirements in American Concrete Institute (ACI) 349.3R, (Reference A4.5) and be consistent with the requirements listed in the North Anna procedure for inspections of plant structures.

No surveillance or inspection procedure currently directs the required aging management monitoring for reinforced concrete pad No. 1. A new concrete pad inspection procedure for structural monitoring of reinforced concrete pad No. 1 will be developed with a five-year inspection interval similar to concrete inspections performed within the plant.

The five-year inspection interval is consistent with applicable operating experience, and helps ensure that cracking, loss of material, and changes in material properties will be detected in a timely manner.

A new inspection procedure will direct that groundwater sampling be performed at two existing wells near reinforced concrete pad No. 1 every five years to determine whether the pad could be exposed to an aggressive chemical environment. The inspection interval of five years has been determined to be appropriate since the reinforced concrete pad No. 1 is not in contact with groundwater. As noted in Table 3.4-2, Groundwater Sample Results Summary, measurements of groundwater chemistry at the ISFSI location confirm that an aggressive environment for concrete does not exist.

Element 5: Monitoring and Trending

The inspection activities in this AMP are performed periodically in order to identify areas of degradation. Results will be evaluated by qualified individuals consistent with industry guidelines, standards, and regulations. Inspection results for structural inspections are retained in Station Records, and are summarized in engineering technical evaluations. Conditions adverse to quality noted during the inspection and monitoring activities, such as non-conformances, failures, malfunctions, deficiencies, deviations, or defective material and equipment are entered into the Dominion Corrective Action Program.

Depending on significance, a more focused evaluation may be required to determine the extent of condition and determine if more frequent monitoring or inspection is required. As discussed below, visual inspections consider the cumulative experience from previous inspections and assessments in order to monitor and trend the progression of aging effects over time. Additionally, the Dominion Corrective Action Program includes trending of adverse conditions as well as a process to prevent recurrence.

A new reinforced concrete pad No. 1 inspection procedure will require the pad to be visually inspected every five years. The inspection results will be evaluated and compared to the previous inspection results to detect adverse trends and determine if the frequency of inspections should be increased. A record of deficiencies found during the credited visual inspection will be updated with results from each inspection. These actions will provide a trending evaluation for the results of inspections for reinforced concrete pad No. 1.

An engineering evaluation will be performed every five years to review industry and plant-specific operating experience (including work order history). The evaluation will also review previous inspection results to determine if any adverse trends are identified warranting additional corrective actions to manage the loss of material, cracking, and change in material properties for reinforced concrete pad No. 1.

Each element of the Monitoring of Structures Aging Management Program will be reviewed to determine if updates are required based on lessons learned from the operating experience review.

Element 6: Acceptance Criteria

Visual inspections for reinforced concrete pad No. 1 will determine whether adverse conditions such as cracking, loss of material, or change in material properties are present. Indications of adverse conditions will be documented using a Condition Report.

Cracks other than hairline cracks are to be noted during visual inspections. As described in ACI 349.3R, Evaluation of Existing Nuclear safety-related Concrete Structures (Reference A4.5), cracking of concrete surfaces is acceptable if all of the following conditions are satisfied by the results of the visual inspection:

- No evidence of leaching
- Pop-outs and voids are less than 20 mm (3/4 in.) in diameter
- Scaling is less than 5 mm (3/16 in.) in depth
- Spalling is less than 10 mm (3/8 in.) in depth and 100 mm (4 in.) in any dimension
- Cracks are passive (no indication of recent growth or indications of other degradation at the crack), and less than 0.4 mm (0.015 in.) in maximum width
- No evidence of excessive deflections, settlements, or other physical movements that could affect structural performance

Groundwater sampling acceptance criteria shall be established as follows:

- Chlorides < 500ppm
- Sulfates < 1,500 ppm
- pH > 5.5

If any one of the three values exceeds the acceptance criterion the condition is entered in the Dominion Corrective Action Program.

These values are consistent with guidance provided in NUREG-1801, Generic Aging Lessons Learned (Reference A4.6), and would demonstrate that reinforced concrete pad No. 1 is exposed to a non-aggressive groundwater environment.

Unacceptable results for cracking of concrete surfaces will require initiation of a Condition Report in accordance with the Dominion Corrective Action Program.

Element 7: Corrective Actions

Corrective actions for deviating conditions that are adverse to quality, e.g., failures, malfunctions, deficiencies, deviations, defective material and equipment, and non-conformances, are performed in accordance with Dominion Topical Report DOM-QA-1, "Nuclear Facility Quality Assurance Program Description" (Reference A4.4). Adherence to DOM-QA-1 ensures that, as required by 10 CFR 50, Appendix B, an adequate quality assurance program is implemented.

The Dominion Corrective Action Program is implemented in accordance with a nuclear fleet administrative procedure. The administrative procedure includes expectations for identification and reporting of conditions adverse to quality, conditions that affect personnel safety, affect nuclear safety, affect plant reliability, affect trending, and other conditions that do not meet station expectations. For conditions determined to be significantly adverse to quality, the procedure provides measures to provide reasonable assurance that the cause of the condition is determined, corrective action is taken in a timely and accurate manner to preclude repetition, and the cause and corrective actions taken are documented and reported to appropriate levels of management. A condition significantly adverse to quality is defined as a condition adverse to quality that has, or if left uncorrected could have, an undesirable effect on plant safety, regulatory position, or environmental impact.

Station deficiencies are identified by the submission of CRs. An attachment to the administrative procedure provides a detailed list of examples of conditions that require submission of a CR. At a minimum, CRs are submitted for any issue or concern that does not meet specific requirements of procedures, policies, management expectations, or accepted industry standards, including all conditions that do not meet the AMP acceptance criteria. CRs are also required to be submitted for any issue where there is doubt about whether a CR should be submitted. The procedure also provides guidance for submittal of CRs anonymously.

Submitted CRs are initially reviewed by the submitters' supervisor. The supervisor answers screening questions to determine if Operations Shift Manager review is required. If so, the shift manager, or designee, performs an operability assessment. As required by 10 CFR 72.75, reportability determinations are also made. Further review of the CR is then performed by the CRT.

The CRT is a multi-discipline, multi-departmental team consisting of members from Engineering, Maintenance, Operations, Radiation Protection, Training, and Organizational Effectiveness. At least one member of the CRT should have, or previously held, a Senior Reactor Operators license. Functions of the CRT include:

- Identifying conditions that are adverse to quality
- Establishing corrective action assignments
- Assigning required significance level and level of evaluation to CRs (e.g., Root Cause Evaluation)
- Reviewing CRs for trending and notifying the Trend Coordinator for submittal of an additional CR to address trending aspects
- Reviewing CRs for safety implications
- Reviewing CRs for initiation of work management activities
- Recommending compensatory measures
- Identifying events that should be communicated to the industry via the INPO Consolidated Event System
- Notifying senior management of significant events

CRs identified as adverse to quality by the CRT are further reviewed by the Corrective Action Assignment Review Team (CAART). The CAART is generally comprised of senior-level management, Manager level and above, and includes the Plant Manager. The CAART reviews the results and recommendations of the CRT and has the authority to make changes when appropriate. The CAART also identifies selected issues to be reviewed by the Facility Safety Review Committee.

The response to corrective action assignments is reviewed to verify the adequacy of the response and proposed corrective actions, including no corrective action. CRT or CAART may assign additional reviews when appropriate.

Engineering evaluations performed in accordance with the Corrective Action Program will determine whether corrective or mitigative actions are needed for maintaining the intended function of providing support for the TN-32 dry storage casks.

A self-assessment is performed at least every two years to determine the effectiveness of the Corrective Action Program. An aggregate review of all open conditions designated as adverse to quality is performed at least every eighteen months to ensure appropriate priorities have been assigned to these outstanding issues.

Element 8: Confirmation Process

Adherence to the Dominion Quality Assurance Program ensures that, as required by 10 CFR Part 50, Appendix B, an adequate quality assurance program is implemented. The Quality Assurance program includes provisions for timely evaluation of adverse conditions, and implementation of any corrective actions required, including root cause evaluations and actions to prevent recurrence. Procedural controls are in place to ensure the response to corrective action assignments is reviewed to verify the adequacy of the response and the corrective actions. Condition reports are also reviewed for trending purposes.

An engineering evaluation will be performed every five years to review industry and plant-specific operating experience (including work order history). The evaluation will also review previous inspection results to determine if any adverse trends are identified warranting additional corrective actions to manage the loss of material, cracking, and change in material properties for reinforced concrete pad No. 1. Each element of the Monitoring of Structures Aging Management Program will be reviewed to determine if updates are required based on lessons learned from the operating experience review.

Element 9: Administrative Controls

All activities associated with the North Anna ISFSI that are important to safety are conducted in accordance with Dominion Topical Report DOM-QA-1, "Nuclear Facility Quality Assurance Program Description" (Reference A4.4). Adherence to DOM-QA-1 ensures that, as required by 10 CFR 50, Appendix B, an adequate quality assurance program is implemented. DOM-QA-1 includes guidance for inspector requirements, record retention requirements, and document control. Administrative and technical procedures are reviewed, approved, and maintained as controlled documents in accordance with the Dominion procedure control process and DOM-QA-1. Administrative controls have been established to ensure records are identified, retained, maintained, and retrievable. Approved procedures define record retention requirements and storage methods.

Element 10: Operating Experience

The Dominion Operating Experience (OE) Program is implemented in accordance with an administrative procedure. The goal of the OE Program is to effectively and efficiently use lessons learned from the industry to improve safety and reliability and to reduce the number and consequence of events. The procedure includes applicability screening of OE reports from the NRC, INPO, and vendors. Guidelines for use of the INPO Nuclear Network Forums are included in the procedure. The procedure also stipulates OE coordinator trending reviews at set frequencies and OE coordinator qualification requirements.

As stated in Element 8: Confirmation Process, additional reviews occur during the engineering evaluation of industry and plant-specific operating experience that occurs every five years to determine whether updates to the aging management program are needed to address lessons learned. The historical absence of significantly adverse findings for the ISFSI confirms that a review interval of five years is sufficient to address the potential need for any changes of aging management programs.

A separate administrative procedure provides instruction for submitting Dominion OE to the INPO Consolidated Event System (ICES). The purpose of this procedure is to provide a method for identification and reporting of INPO ICES reports. The procedure includes reporting criteria and required reporting time frames.

OE reviews for this AMP are based on relevant occurrences listed in the North Anna Corrective Action database, i.e., condition reports, and a search of the INPO OE summaries for industry experiences for domestic and international plants. These documents were reviewed for any applicable aging effects or mechanisms. Searches of those databases used the following keywords:

- ISFSI pad
- ISFSI
- Concrete

OE at North Anna indicates that the Monitoring of Structures Aging Management Program for plant structures has been effective in identifying structural degradation, implementing corrective actions, and trending the findings. When degradation has been identified for plant structures, corrective actions have been implemented to ensure that the integrity of the affected structure is restored and maintained such that intended functions will be maintained during the period of extended operation.

Specific examples of relevant OE for age-related degradation of reinforced concrete pad No. 1 are listed below:

A 2004 engineering evaluation summarized inspections which were performed for the North Anna ISFSI reinforced concrete pad No. 1 in 1998, 1999, and 2004. The pad was constructed in five placements in December 1997. After the first placement, a condition report was written identifying discrepancies with the location of reinforcing bars, and supports for the embedded TN-32 dry storage cask lighting boxes. The findings of the resultant engineering evaluation concluded that the structural strength of the pad had not been reduced and the discrepancies were corrected prior to the remaining four placements. The evaluation recommended that Engineering inspect this same area within six months to identify any cracking that may have occurred, and perform an additional follow-up inspection approximately one year later.

Reinforced concrete pad No. 1 was first inspected on May 13, 1998. The inspection identified no adverse conditions beyond those previously reported, and no repairs were required at that time. Pad No. 1 was re-inspected on May 20, 1999, and was reported to be in good condition. Additional surface cracks were identified and previously-identified cracks were characterized to be wider than previously reported. The cracks were reported to be very shallow in depth and not a concern, so no repairs were required following the inspection. An engineering evaluation issued on May 27, 1999, reiterated a recommended action, based on the initial condition report to re-inspect reinforced concrete pad No. 1 in five years. No additional condition report was initiated since the recommended actions of the initial condition report continued to be followed.

Reinforced concrete pad No. 1 was reinspected on April 6, 2004. Twenty-one TN-32 dry storage casks had been placed on the pad by this time. Observations from the three inspections in 1998, 1999, and 2004 were recorded on sketches that were included with the summary engineering evaluation to support trending. Reinforced concrete pad No. 1 had cracks immediately adjacent to construction or control joints that had begun to unravel into the joint as anticipated, and were reported as joint spalls. In general, crack widths had stabilized and remained consistent with the inspection results reported in 1999. Light crazing (i.e., a network of fine cracks on the surface of the concrete) was present on numerous areas of reinforced concrete pad No. 1. The identified indications were shallow and did not jeopardize the structural integrity of reinforced concrete pad No. 1. The areas of crazing for the surface of reinforced concrete pad No. 1 were noted on the sketches that accompanied the summary engineering evaluation.

A post-seismic event walkdown of the ISFSI pad (reinforced concrete pad No. 1 for the TN-32 dry storage casks), including all support systems, was performed on September 1, 2011 to verify current conditions. Reinforced concrete pad No. 1 was checked, and no additional cracks or deformation were noted during this post-seismic walkdown.

During the performance of the pre-application inspections on October 14, 2015, reinforced concrete pad No. 1 was inspected as well as the concrete underneath the TN-32 dry storage cask that was lifted. Civil Engineering performed a visual inspection of the concrete under the TN-32 dry storage cask, as well as the entire pad, and had no concerns with the condition of reinforced concrete pad No. 1. The only cracking is hairline in nature, but does not require repair. This recent inspection of reinforced concrete pad No. 1 confirms the absence of age-related degradation. See Section F2.2, Pre-application Inspection Results for additional information.

The history of inspections for reinforced concrete pad No. 1 dates back to 1998. Results from five inspections in 1998, 1999, 2004, 2011, and 2015 confirm that cracks have formed on the surface of the pad, but none are affecting the structural integrity of the concrete or require repair.

A trend of inspection results that is maintained for reinforced concrete pad No. 1 shows that existing cracks are shallow and have stabilized. The shallow cracks have not provided a pathway for the atmosphere/weather environment to come into contact with the embedded steel and initiate corrosion which could adversely affect structural integrity.

The OE presented above provides reasonable assurance that the Monitoring of Structures Aging Management Program will be capable of detecting aging effects for reinforced concrete pad No. 1. Occurrences of aging that would be identified under the Monitoring of Structures Aging Management Program will be evaluated to ensure there is no loss of intended function. Guidance for re-evaluation, repair, or replacement is provided for locations where aging is found. There is confidence that continued implementation of the Monitoring of Structures Aging Management Program will effectively identify aging prior to loss of intended function.

Summary of Enhancements

The following enhancements will be made to the Monitoring of Structures Aging Management Program:

1. Perform an engineering evaluation every five years to review industry and plant-specific operating experience (including work order history). The evaluation will also review previous inspection results to determine if any adverse trends are identified warranting additional corrective actions to manage the loss of material, cracking, and change in material properties for reinforced concrete pad No. 1. Each element of Monitoring of Structures Aging Management Program will be reviewed to determine if updates are required based on lessons learned from the OE review.
2. Perform a visual inspection of the visible surfaces of reinforced concrete pad No. 1 at a frequency of every five years. The acceptance criteria is specified in ACI-349.3R.
3. Perform groundwater sampling at the ISFSI site to determine values for chlorides, sulfates, and pH at two groundwater wells every five years. The acceptance criteria are:
    - Chlorides < 500ppm
    - Sulfates < 1,500 ppm
    - pH > 5.5
4. Perform an opportunistic inspection of the normally inaccessible area of reinforced concrete pad No. 1 beneath the TN-32 dry storage cask whenever a cask is lifted.
5. Perform an opportunistic inspection of the inaccessible below-grade portions of reinforced concrete pad No. 1 if made available by excavation. The acceptance criteria is specified in ACI-349.3R.

Conclusion

Based on the operating experience review and pre-application inspection results, the reinforced concrete pad No. 1 intended functions have not been challenged by age-related degradation. Existing procedures, along with proposed enhancements, provide reasonable assurance that the intended functions will be maintained consistent with the ISFSI design basis during the period of extended operation.

A3.0 SUMMARY

Operating experience indicates that while degradation of the TN-32 dry storage cask exterior surfaces has occurred, e.g., flaking of TN-32 dry storage cask coating, there have been no cases of loss of intended function due to dry storage cask exterior problems. Corrective actions have been effectively implemented when monitoring and inspection results have indicated degradation. On the basis of this on-going surveillance, the infrequency of observed instances of degradation, and corrective actions implemented, the effects of aging on the TN-32 dry storage casks will be effectively managed during the period of extended operation.

Operating experience from five inspections of reinforced concrete pad No. 1 confirm the absence of age-related degradation which could jeopardize the structural integrity of the pad. OE has not resulted in any changes for existing structural inspection procedures, or a need to invoke repair procedures.

The effects of aging associated with subcomponents within the scope of the TN-32 Dry Storage Cask Aging Management Program and the Monitoring of Structures Aging Management Program will be adequately managed so that there is reasonable assurance that their intended functions will be performed consistently with the design basis during the period of extended operation.

A4.0 REFERENCES (Appendix A: Aging Management Programs)

A4.1 North Anna Independent Spent Fuel Storage Installation Safety Analysis Report, Rev. 8, North Anna Power Station. ML14233A488

A4.2 Technical Specifications, Independent Spent Fuel Storage Installation, Amendment 4, North Anna Power Station.

A4.3 NUREG-1927, Standard Review Plan for Renewal of Licenses and Certificates of Compliance for Dry Storage of Spent Nuclear Fuel, Rev. 0, Office of Nuclear Material Safety and Safeguards, Nuclear Regulatory Commission.

A4.4 DOM-QA-1, Nuclear Facility Quality Assurance Program Description, Topical Report, Dominion.

A4.5 ACI 349.3R, Evaluation of Existing Nuclear Safety Related Concrete Structures, American Concrete Institute, 2002.

A4.6 NUREG-1801, Generic Aging Lessons Learned (GALL) Report, Rev. 2. ML103490041

APPENDIX B

TIME-LIMITED AGING ANALYSES

(TLAAs)

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APPENDIX B: TIME-LIMITED AGING ANALYSES (TLAAs)

B1.0 INTRODUCTION

Per 10 CFR 72.42(a)(1), an ISFSI license renewal application must include Time-Limited Aging Analyses (TLAAs) that demonstrate that Structures, Systems and Components (SSCs) important to nuclear safety will continue to perform their intended functions for the requested period of extended operation (Reference B3.2). This Appendix outlines the screening process used to identify design basis calculations that may be time-limited upon extending the ISFSI license by 40 additional years.

As part of the North Anna ISFSI license renewal process, a TLAA review was performed to identify calculations and analyses meeting the six selection criteria listed in the 10 CFR 72.3 definition of "TLAA" (Reference B3.2). As described below, the review did not identify any TLAAs for North Anna ISFSI SSCs within the scope of license renewal.

B2.0 IDENTIFICATION OF TIME-LIMITED AGING ANALYSES

TLAAs are described in NUREG-1927 as calculations or analyses used to demonstrate that in-scope SSCs will maintain their intended function throughout an explicitly stated period of operation (Reference B3.1). To be considered a TLAA, the calculations or analyses must meet all six of the following criteria defined in 10 CFR 72.3: (Reference B3.2)

1. Involve SSCs "Important to Nuclear Safety," as delineated in Subpart F of 10 CFR 72, or within the scope of the spent fuel storage CoC renewal as delineated in Subpart L of 10 CFR 72, respectively;
2. Consider the effects of aging;
3. Involve time-limited assumptions defined by the current operating term;
4. Determined to be relevant in making a safety determination that exists in the design basis;
5. Involve conclusions or provide the basis of conclusions related to capability of the SSCs to perform their intended safety functions; and
6. Are contained or incorporated by reference in the design basis.

Analyses meeting all of the above criteria are dispositioned using one of the following three approaches:

1. The analyses will remain valid for the license period of extended operation; or
2. The analyses have been projected to the end of the period of extended operation; or
3. The effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

B2.1 Identification Process and Results of the Time-Limited Aging Analyses

As indicated in Table 2.3-2, Scoping Results, there are three SSCs within the scope of license renewal for the North Anna site-specific ISFSI that are considered for TLAA: 1) TN-32 dry storage cask, 2) spent fuel assemblies, and 3) reinforced concrete pad No. 1.

The TLAA process involved a "screening" review of design basis documents (including docketed correspondence, Technical Specification and/or License changes), and calculations considered in the TN-32 Dry Storage Cask Topical Safety Analysis Report (Reference B3.3) and the ISFSI SAR (Reference B3.4), which address the three SSCs within the scope of license renewal for the North Anna ISFSI. Appendix A.1 of the ISFSI SAR documents approved changes to the ISFSI design basis from the design basis information presented in Revision 9A of the TN-32 Dry Storage Cask Topical Safety Analysis Report. These changes to the ISFSI SAR were also reviewed to identify any TLAAs.

As a result of the review of these design basis documents, the analyses or calculations identified as not being time-dependent were not considered further. Finally, a more detailed evaluation of the remaining "potential" TLAA calculations was performed to determine which, if any, met the six criteria used to define a TLAA.

Based on the review, no TLAAs were identified for North Anna ISFSI SSCs in the scope of license renewal.

B3.0 REFERENCES (APPENDIX B: TIME-LIMITED AGING ANALYSES)

B3.1 NUREG-1927, Standard Review Plan for Renewal of Spent Fuel Dry Cask Storage System Licenses and Certificates of Compliance, Rev. 0.

B3.2 10 CFR 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater than Class C Waste.

B3.3 TN-32 Dry Storage Cask Topical Safety Analysis Report, Rev. 9A, Transnuclear, Inc., December 1996.

B3.4 North Anna Independent Spent Fuel Storage Installation Safety Analysis Report, Rev. 8, North Anna Power Station. ML14233A488

APPENDIX C

ISFSI SAFETY ANALYSIS REPORT (SAR)

SUPPLEMENT

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APPENDIX C: ISFSI SAR SUPPLEMENT

C1.0 INTRODUCTION

This appendix provides a proposed supplement to the North Anna ISFSI Safety Analysis Report (SAR). Section C2.0 of this appendix contains a proposed new section for the ISFSI SAR to be added under Chapter 9, Conduct of Operations. Section C3.0 of this appendix identifies changes to the existing ISFSI SAR that are necessary to reflect the period of extended operation.

The proposed new ISFSI SAR Section 9.7, Aging Management, provides a brief description of the activities for managing the effects of aging. This proposed new ISFSI SAR section also provides a summary of the analysis of time-limited aging analyses (TLAAs) for the period of extended operation. Following issuance of the renewed license (SNM-2507) for the North Anna ISFSI, Dominion will incorporate the proposed supplement in the North Anna ISFSI SAR as part of a periodic SAR update in accordance with 10 CFR 72.70(c).

C2.0 PROPOSED NEW NORTH ANNA ISFSI SAR SECTIONS

C2.1 Aging Management (New ISFSI SAR Section 9.7)

Renewal of North Anna ISFSI license SNM-2507 involved 1) Scoping, 2) Aging Management Review (AMR), and 3) Aging Management. Scoping of systems, structures and components (SSCs) identified the ISFSI major components in the scope of license renewal. The AMR process evaluated the SSCs in the scope of license renewal for applicable aging effects and mechanisms based on material and environment. Aging Management Programs (AMPs) were developed to adequately manage the effects of aging.

The scoping results identified the TN-32 dry storage cask, the spent fuel assemblies stored in the cask, and reinforced concrete pad No. 1 as being in the scope of license renewal.

The AMR addressed aging effects/mechanisms that could adversely affect the ability of the structures or components to perform their intended functions during the period of extended operation. The results of the AMR determined that there are aging effects that require aging management for both the TN-32 dry storage cask and reinforced concrete pad No. 1. The potential aging effects for the cask and concrete pad No. 1 are identified in Table C2.1-1, Table of Aging Effects (New ISFSI SAR Table 9.7-1).

Table C2.1-1 Table of Aging Effects (New ISFSI SAR Table 9.7-1)

Material	Environment	Aging Effect	Mechanism
Aluminum	Atmosphere / Weather	Loss of Material	Crevice Corrosion
			Pitting Corrosion
			Galvanic Corrosion
Carbon Steel and Low-Alloy Steel	Atmosphere / Weather	Loss of Material	Crevice Corrosion
			Pitting Corrosion
			Galvanic Corrosion
			General Corrosion
Stainless Steel	Atmosphere / Weather	Loss of Material	Crevice Corrosion
			Pitting Corrosion
Polypropylene (encased in carbon steel)	Air	Loss of Material	Radiolytic Decomposition
			Thermal Degradation
Borated Polyester (encased in Aluminum)	Air	Loss of Material	Radiolytic Decomposition
			Thermal Degradation
Concrete	Atmosphere / Weather	Loss of Material	Freeze-thaw
		Cracking	Freeze-thaw
			Reaction with Aggregates
		Change in Material Properties	Leaching of Calcium Hydroxide
	Soil	Cracking	Reaction with Aggregates
			Settlement

A review of AMPs needed to manage the effects of aging identified existing aging management activities and the need to add new aging management activities. The AMPs provide reasonable assurance that the ISFSI reinforced concrete pad No. 1 and TN-32 dry storage cask subcomponents within the scope of license renewal will continue to perform their intended functions consistent with the design basis for the period of extended operation. The following sections describe aging management program activities used to manage the effects of aging.

C2.1.1 Aging Management Programs (New ISFSI SAR Section 9.7.1)

C2.1.1.1 TN-32 Dry Storage Cask Aging Management Program (New ISFSI SAR Section 9.7.1.1)

This Aging Management Program defines the aging management activities which are necessary to help ensure the integrity of the TN-32 dry storage casks manufactured by AREVA-Transnuclear.

The North Anna ISFSI is a facility to place and store spent fuel in licensed containers (dry storage casks) until such time that the fuel may be shipped off-site for final disposition. The TN-32 dry storage casks at the North Anna ISFSI are designed for outdoor storage.

The aging management activities described and credited to manage the effects of aging for the TN-32 dry storage casks will provide reasonable assurance that there will not be a loss of intended function.

Specifically, the TN-32 Dry Storage Cask Aging Management Program ensures loss of material from the cask subcomponents will be identified and managed during the period of extended operation prior to loss of intended function.

The TN-32 Dry Storage Cask Aging Management Program includes 1) continuous interseal pressure monitoring of the in-service dry storage casks, 2) quarterly visual inspection of dry storage casks that are in-service at the North Anna ISFSI, and 3) TLD radiation monitoring at the ISFSI perimeter fence.

The following additional activities are included in the TN-32 Dry Storage Cask Aging Management Program to ensure the aging effect of concern is adequately managed during the period of extended operation:

1. Perform an engineering evaluation every five years to review industry and plant-specific operating experience (including work order history). The evaluation will also review previous inspection results to determine if any adverse trends are identified warranting additional corrective actions to manage the loss of material from the TN-32 dry storage casks. Each element of the TN-32 Dry Storage Cask Aging Management Program will be reviewed to determine if updates are required based on lessons learned from the operating experience review.
2. Perform an opportunistic visual inspection of a TN-32 dry storage cask bottom and under the protective cover in the event a cask is lifted or a protective cover is removed.

3. Perform a visual inspection of a TN-32 dry storage cask bottom and under the protective cover at least every 20 ± 5 years. The selection criteria for this scheduled inspection will utilize the same criteria as that used for the pre-application inspection. The five-year periodic reviews of operating experience, as well as changes to the aging management program resulting from the review, will be considered during cask selection.
4. Perform an annual evaluation of neutron and gamma quarterly TLD readings to confirm the absence of an increasing trend (as determined by engineering evaluation).

Visual inspections identify degradation of the physical condition of the exterior surfaces of the TN-32 dry storage cask. These inspections check for loss of material (corrosion) from the TN-32 dry storage cask. Pressure monitoring of the dry storage cask provides a means to detect seal degradation. Radiation monitoring provides a means to detect degradation of shielding material internal to the TN-32 dry storage casks.

The acceptance criteria for the quarterly visual inspection are:

- No coating defects (bubbling/blistering of paint)
- No loose debris in contact with the cask(s)
- No rust spots and stains
- No rust stains on the concrete
- No physical damage
- No baseplate corrosion at the concrete/cask interface

The acceptance criterion for the opportunistic and 20-year scheduled visual inspections is no detectable loss of material from the base metal as determined by the results of the VT-1 and/or VT-3 visual inspection.

The acceptance criterion for interseal pressure monitoring is the absence of a low pressure alarm.

The acceptance criterion for the annual evaluation of neutron and gamma quarterly TLD readings is the absence of an increasing trend (as determined by engineering evaluation).

Monitoring and inspection results that exceed established acceptance criteria will be entered in the Corrective Action Program. Engineering evaluations determine if conditions identified as adverse to quality are significant enough to compromise the ability of a TN-32 dry storage cask to perform its intended functions.

C2.1.1.2 Monitoring of Structures Aging Management Program (New ISFSI SAR Section 9.7.1.2)

The Monitoring of Structures Aging Management Program defines the aging management activities which are necessary to help ensure the integrity of reinforced concrete pad No. 1. Reinforced concrete pad No. 1 on which the TN-32 dry storage casks rest is an above-ground, outdoor installation. The Monitoring of Structures Aging Management Program verifies the capability of reinforced concrete pad No. 1 to perform its intended functions.

Specifically, the Monitoring of Structures Aging Management Program ensures that cracking, change in material properties, and loss of material from reinforced concrete pad No. 1 will be identified and managed during the period of extended operation prior to loss of intended function.

The Monitoring of Structures Aging Management Program includes the following activities:

1. Perform an engineering evaluation every five years to review industry and plant-specific operating experience (including work order history). The evaluation will also review previous inspection results to determine if any adverse trends are identified warranting additional corrective actions to manage the loss of material, cracking, and change in material properties for reinforced concrete pad No. 1. Each element of the Monitoring of Structures Aging Management Program will be reviewed to determine if updates are required based on lessons learned from the operating experience review.
2. Perform a visual inspection of the visible surfaces of reinforced concrete pad No. 1 every five years.
3. Perform groundwater sampling at the ISFSI site to determine values for chlorides, sulfates, and pH at two groundwater wells every five years.
4. Perform an opportunistic inspection of the normally inaccessible area of reinforced concrete pad No. 1 beneath a TN-32 dry storage cask in the event a dry storage cask is lifted.
5. Perform an opportunistic visual inspection of the inaccessible below-grade portions of reinforced concrete pad No. 1, if made available by excavation.

Periodic visual monitoring is performed to determine the surface condition of reinforced concrete pad No. 1, which is a leading indicator for the overall integrity of the pad. Visual inspections detect surface defects resulting from the aging mechanisms of reaction with aggregates, freeze-thaw, leaching of calcium hydroxide, or settlement.

Surface indications of age-related degradation for reinforced concrete pad No. 1 include:

- Loss of material
- Cracking
- Change in material properties (white stains, indicative of leaching)

The acceptance criteria listed in ACI 349.3R is used for all visual inspections.

Chlorides, sulfates, and pH are monitored. Groundwater sampling is performed at two locations at the ISFSI every five years. The acceptance criteria for groundwater monitoring are:

1. Chlorides < 500ppm
2. Sulfates <1,500ppm
3. pH >5.5

Reinforced concrete pad No. 1 is not located in the groundwater. However, a groundwater chemistry monitoring program will be established to provide supplemental information for identifying conditions conducive to underground aging mechanisms.

Monitoring and inspection results that exceed established acceptance criteria are entered in the Corrective Action Program. Engineering evaluations determine if conditions identified as adverse to quality are significant enough to compromise the ability of reinforced concrete pad No. 1 to perform its intended functions.

C2.2 Time-Limited Aging Analyses (New ISFSI SAR Section 9.7.2)

As required by 10 CFR 72.42(a)(1), an application for a renewed ISFSI license must include ISFSI-specific TLAAs. The TLAA identification process required a review of the design basis documents and calculations to provide a reasonable assurance that TLAAs were identified.

Once a TLAA is identified, an evaluation is performed to disposition each ISFSI-specific TLAA using one of three different approaches described below:

i. The analyses will remain valid for the period of extended operation.

ii. The analyses have been projected to the end of the period of extended operation.

iii. The effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

Based on review of design basis documents and calculations, no TLAAs were identified for the North Anna ISFSI.

C3.0 PROPOSED CHANGES TO EXISTING NORTH ANNA ISFSI SAR

C3.1 ISFSI SAR Section A.1.3: Criticality Evaluation

Revise the second to last paragraph of the ISFSI SAR Section A.1.3 to reflect evaluation of the fixed neutron poison in the TN-32 dry storage cask:

"....An appraisal of the fixed neutron poisons has shown that they will remain effective for the ~~20~~ 60-year storage period, and there is no credible way to lose them. The analysis and evaluation of the criticality design and performance have demonstrated that the cask will provide for the safe storage of spent fuel for a minimum of ~~20~~ 60 years with an adequate subcritical margin."

This change reflects the extended license period to 60 years and is based on previous analysis showing that boron depletion is negligible for storage periods well beyond 60 years.

C3.2 ISFSI SAR Section A.1.4: Thermal Evaluation

Revise the last paragraph of ISFSI SAR Section A.1.4 to reflect evaluation of the thermal design of the TN-32 dry storage cask:

"The thermal design of the TN-32 cask is in compliance with 10 CFR 72 and applicable design and acceptance criteria have been satisfied. The evaluation of the thermal design provides reasonable assurance that the TN-32 cask will allow the safe storage of spent fuel for ~~20~~ 60 years."

This change reflects the extended license period to 60 years. Since the maximum temperature for the cask and the fuel stored within the cask during the storage period is realized immediately after loading spent fuel into the cask and fuel temperature decreases with time, the thermal calculations supporting storage for the extended license period remain valid.

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APPENDIX D

TECHNICAL SPECIFICATION CHANGES

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APPENDIX D: TECHNICAL SPECIFICATION CHANGES

10 CFR Part 72.42 lists the requirements that a licensee must meet for renewal of an independent spent fuel storage installation (ISFSI) license. 10 CFR Part 72.42 requires that an application for license renewal include any Technical Specification changes, or additions that are necessary to manage the effects of aging during the period of extended operation. A review of the information provided in this License Renewal Application and the North Anna ISFSI Technical Specifications confirms that no changes to the ISFSI Technical Specifications are necessary.

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APPENDIX E

ENVIRONMENTAL REPORT

SUPPLEMENT

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ACRONYMS AND ABBREVIATIONS

ALARA	As Low as Reasonably Achievable
AQCR	air quality control region
CFR	Code of Federal Regulations
CISF	consolidated interim storage facility
COL	combined license
CVSZ	Central Virginia seismic zone
DOE	U.S. Department of Energy
ER	environmental report
ESP	early site permit
FE	Federal endangered
FS	Federal species of concern
FT	Federal threatened
ISFSI	independent spent fuel storage installation
M	moment magnitude
NAPS	North Anna Power Station
NMFS	National Marine Fisheries Service
NRC	U.S. Nuclear Regulatory Commission
REMP	Radiological Environmental Monitoring Program
SAR	Safety Analysis Report
SE	State endangered
SHPO	State Historic Preservation Officer
ST	State threatened
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
WHTF	Waste Heat Treatment Facility

APPENDIX E: ENVIRONMENTAL REPORT SUPPLEMENT

E1.0 Introduction

E1.1 Purpose and Need for the Proposed Action

The U.S. Nuclear Regulatory Commission (NRC) licenses the operation of independent spent fuel storage installations (ISFSIs) for storing power reactor spent fuel and associated radioactive materials in accordance with the Atomic Energy Act of 1954 (42 United States Code [USC] 2011, et seq.) and NRC implementing regulations (10 CFR 72). On June 30, 1998, NRC issued Virginia Electric and Power Company (Dominion or Dominion Virginia Power) and Old Dominion Electric Cooperative (ODEC) site-specific license (SNM-2507) valid for 20 years to receive, possess, store, and transfer the North Anna Power Station (NAPS) Units 1 and 2 spent fuel to TN-32 sealed storage casks (TN-32 casks) at an ISFSI located on the North Anna site.

As described in Section 1.0, this Application is limited to seeking renewal of the specific ISFSI license (License Number SNM-2507). The approved ISFSI design basis, as stated in Section 1.1 of the North Anna ISFSI SAR, indicates that up to three concrete storage pads could be used under the specific ISFSI license. Reinforced concrete pad No. 1 construction is complete. An additional pad under a 10 CFR Part 72 Subpart L general license was installed in place of planned reinforced concrete pad No. 2 of the specific ISFSI license. There are no current plans to expand the pad capacity under the specific license beyond reinforced concrete pad No. 1, but Dominion and ODEC retain the authority to do so under the terms of the North Anna specific ISFSI license.

The purpose and need for the proposed action, renewal of the North Anna ISFSI license, is to provide an option that allows for continued interim spent fuel storage on reinforced concrete pad No. 1, and, indirectly, power generation capability, to meet future system generating needs.

Storage capacity in the NAPS spent fuel pool, accounting for necessary reserve capacity, was reached in 2000, continuing the need for an ISFSI. Operation of NAPS Units 1 and 2 is now dependent on the continued ability of the ISFSI to store existing and additional spent fuel, and therefore, the ISFSI must be available for the expected duration of the plant operating licenses. The Units 1 and 2 operating licenses were renewed in 2003 for extended terms ending in 2038 and 2040, respectively (68 FR 15246). In addition, the ISFSI must be available to store spent fuel until the U.S. Department of Energy (DOE) accepts all of the spent fuel stored at North Anna.

E1.2 Proposed Action

The proposed action is to renew site-specific license, SNM-2507, of the North Anna ISFSI for an additional 40 years beyond the current license term, or through June 30, 2058.

On June 30, 1998, the NRC issued Dominion and ODEC a 20-year license to receive, possess, store, and transfer the NAPS Units 1 and 2 spent nuclear fuel to an ISFSI located on the North Anna site. Discharged spent fuel assemblies from both units are stored in a common spent fuel pool. The spent fuel pool provides for interim storage of 1,737 fuel assemblies in high density storage racks (Reference E9.1, Section 9.1.2). Typically, 64 spent fuel assemblies are discharged from each unit about every 18 months. Approximately 96 spent fuel assemblies are transferred from the spent fuel pool into dry storage casks and taken to the ISFSI each year.

ISFSI reinforced concrete pad No. 1 has been analyzed for storage of 28 TN-32 casks, but currently contains 27 TN-32 casks. Dominion has a pending amendment to SNM-2507 to use a modified TN-32B cask (TN-32B HBU) to store high burnup spent fuel for North Anna Units 1 and 2. If approved, one TN-32B HBU cask will be added to reinforced concrete pad No. 1. As noted above, Dominion, as operator of the ISFSI, has no current plans to expand the pad capacity under the specific license beyond reinforced concrete pad No. 1. But as Dominion and ODEC retain the authority to expand the ISFSI capacity under the specific license up to 839.04 metric tons of uranium, the potential environmental impacts of such expansion are considered below.

Extending the specific license for the ISFSI will support continued storage of spent fuel on reinforced concrete pad No. 1, the continued operation of NAPS through potential expansion of pad capacity under the specific license, and allow Dominion to maintain safe storage of the spent fuel until its acceptance by DOE for removal from the site following cessation of Unit 1 and 2 operations.

E1.2.1 Licensing History

The original Technical Specifications for the specific ISFSI license limited fuel to be stored in the TN-32 dry storage casks to an initial enrichment value less than or equal to 3.85 percent by weight U-235, an assembly average burnup less than or equal to 40,000 megawatt days per metric ton of uranium (MTU), and a heat generation value less than or equal to 0.847 kW/assembly. In July 2003, in response to a Dominion request, the NRC issued an amendment to SNM-2507 that revised its Technical Specifications to permit the use of TN-32 dry storage casks to store spent fuel with a higher initial enrichment and burnup (68 FR 41023).

Specifically, the amendment revised the Technical Specifications to permit use of the TN-32 dry storage casks to store fuel with an initial enrichment value less than or equal to 4.35 percent by weight U-235, an assembly average burnup less than or equal to 45,000 megawatt days per MTU, and a heat generation value less than or equal to 1.02 kW/assembly in the TN-32 dry storage casks (68 FR 35013). Additionally, as noted above, Dominion has a pending amendment to SNM-2507 to use a modified TN-32B cask (TN-32B HBU) to store high burnup spent fuel for North Anna Units 1 and 2.

On August 23, 2011, a moment magnitude (M) 5.8 earthquake occurred near Mineral, Virginia, approximately 11 miles from North Anna. During the seismic event, 25 of the 27 TN-32 dry storage casks on reinforced concrete pad No. 1 shifted from their original positions by up to approximately four inches. Dominion performed detailed inspection and monitoring of the casks to confirm there were no damages having any impact on safety-related features (Reference E9.2). Thermal, nuclear, and structural analyses were subsequently conducted to support modifying the minimum allowable cask spacing from 16 feet nominal to 14 feet for casks with heat load no greater than 27.1kW to account for the position shift (Reference E9.3). In 2015, NRC approved a license amendment that revised the Technical Specifications of SNM-2507 to modify the minimum allowable cask center-to-center spacing requirements from 16 feet nominal to 14 feet for casks with heat load no greater than 27.1kW (Reference E9.4).

E1.2.2 Operations

The site-specific license authorizes storage of up to 839.04 metric tons of uranium on up to three concrete storage pads. Currently, the ISFSI site-specific license consists of one pad with 27 fully-loaded TN-32 dry storage casks. An additional pad, operating under a 10 CFR Part 72, Subpart L general license, was installed in the location originally planned for SNM-2507 reinforced concrete pad No. 2. Dominion anticipates future dry cask storage of spent fuel at NAPS, including construction of any additional pads, will take place under the general license.

Each TN-32 dry storage cask is a right circular cylinder capable of housing up to 32 pressurized water reactor spent fuel assemblies. An internal fuel basket provides alignment and separation of the spent fuel assemblies. Helium gas is pumped into the casks during the loading-sealing process to provide an inert atmosphere. A lid and seals provide an effective boundary between the internal helium environment and the outside environment. An overpressure system, consisting of pressure sensors, overpressure tank, and alarms, warns of helium leakage through the cask lid seals. The cask design includes shielding to reduce external radiation levels. The cask is also designed to passively dissipate the decay heat generated by the stored spent fuel. As a result, the cask provides adequate heat removal capacity to maintain safe fuel clad temperatures without active cooling systems.

Low-level radioactive waste is not generated during storage of the TN-32 dry storage casks at the ISFSI or during transport to/from the ISFSI. Radioactive wastes generated during loading operations in the station Fuel and Decontamination Buildings will be treated using existing NAPS radioactive waste management systems.

Contaminated spent fuel pool water from loaded TN-32 dry storage casks will normally be drained back into the spent fuel pool with no additional processing prior to transport. It is estimated that less than 100 gallons of liquid waste results from each exterior cask decontamination. Liquid wastes are directed to the Fluid Waste Treatment Tank for transfer to the liquid waste processing system. Processed water may be recovered for use in the plant or discharged, as appropriate.

Potentially contaminated air and helium purged from the TN-32 dry storage casks during loading and unloading will be handled by the Fuel and Decontamination Buildings ventilation systems. Ventilation air from these buildings is exhausted through filter banks consisting of roughing, particulate, and charcoal filters in series.

Low-level solid waste generated during cask loading operations could include disposable anti-contamination garments and plastic sheeting, tape, and rags, and will be managed using the solid waste processing system.

Existing NAPS staff currently perform the daily activities associated with operation of the ISFSI facility, including maintenance. No additional staff or offsite personnel will be required for operations and maintenance during the period of extended operation. The ISFSI has lighting and a backup diesel generator. A security fence surrounds the facility. The passive nature of the facility minimizes maintenance beyond security monitoring and periodic walkdown surveillance.

No construction or refurbishment beyond normal maintenance and aging management is currently planned for TN-32 dry storage cask storage during the ISFSI period of extended operation. Due to the delay in establishing a permanent federal repository, the spent nuclear fuel from the North Anna reactors will be stored onsite for an extended period. The ISFSI is subject to aging management activities to ensure the integrity of the dry storage casks during the ISFSI license renewal term. The aging management programs are summarized in Appendix A of this license renewal application.

E1.3 Environmental Report Scope and Methodology

Dominion has prepared this supplemental environmental report (ER) as part of its application to the NRC to renew the site-specific ISFSI license in accordance with the following NRC regulations:

- 10 CFR Part 72, Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste, 72.42, Duration of License; Renewal, and 72.34, Environmental Report
- 10 CFR Part 51, Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions, 51.60, Environmental Report-Materials Licenses

10 CFR 72.42 provides for ISFSI license renewal and 10 CFR 72.34 requires an application to include an ER that meets the requirements of 10 CFR 51 Subpart A. In Subpart A, 10 CFR 51.60 requires that the ER be a separate document entitled "Supplement to Applicant's Environmental Report" and specifies ER contents. The regulation focuses on presenting any significant environmental change from the previously submitted ER.

In determining what information to include in the ISFSI ER supplement, Dominion has relied on guidance provided in NUREG-1748 (Reference E9.5). NRC guidance indicates that license renewal is not an exercise in re-licensing and is not intended to impose requirements beyond those that were met by the facility when it was initially licensed. Dominion assembled a team to review the ER submitted with the original NAPS ISFSI license application and NRC's subsequent environmental analysis to identify areas that require updating to meet the expectations of NUREG-1748. The review included evaluation of any significant changes during the initial licensing period and considered whether significant changes are anticipated during the period of extended operation.

Dominion has prepared Table E1-1 to verify conformance with the regulatory requirements. Table E1-1 provides the locations of ER content that respond to regulatory requirements.

Table E1-1 Environmental Report Section(s) that Correspond to License Renewal Environmental Regulatory Requirements

Regulatory Requirements	Responsive ER Section(s)
10 CFR 72.34	Entire Document
10 CFR 51.60(a)	Entire Document
10 CFR 51.45(a)	Entire Document
10 CFR 51.45(b) statement of purpose	E1.1, Purpose and Need for the Proposed Action
10 CFR 51.45(b) description of proposed action	E1.2, Proposed Action
10 CFR 51.45(b) affected environment	E3.0, Affected Environment
10 CFR 51.45(b)(1) impact of proposed action	E4.0, Environmental Impacts
10 CFR 51.45(b)(2) adverse environmental effects	E4.0, Environmental Impacts
	E8.1, Unavoidable Adverse Impacts
10 CFR 51.45(b)(3) alternatives to proposed action	E2.0, Alternatives
10 CFR 51.45(b)(4) short-term use and long-term productivity	E8.3, Short-Term Uses, Maintenance, and Enhancement of Long-Term Productivity
10 CFR 51.45(b)(5) irreversible and irretrievable commitments	E8.2, Irreversible and Irretrievable Commitment of Resources
10 CFR 51.45(c) alternatives for reducing or avoiding effects	E4.0, Environmental Impacts
	E5.0, Mitigation Measures
	E6.0, Environmental Measurement and Monitoring
10 CFR 51.45(c) cost/benefit analysis	E7.0, Cost-Benefit
10 CFR 51.45(d)	E1.4, Applicable Regulatory Requirements, Permits, and Required Consultations

To develop this ER supplement, Dominion references material in the original ISFSI ER (Reference E9.6) and NRC Environmental Assessment (Reference E9.7). This ER supplement further references the North Anna early site permit (ESP) application ER (Reference E9.8) and associated NRC environmental impact statement (EIS) (Reference E9.9), the North Anna Unit 3 combined license (COL) application ER (Reference E9.10) and associated NRC Supplemental EIS (Reference E9.11), and the NAPS Units 1 and 2 license renewal application ER (Reference E9.19) for detailed characterizations of the surrounding environment.

E1.4 Applicable Regulatory Requirements, Permits, and Required Consultations

The North Anna ISFSI does not require any additional permits, licenses, or approvals to operate other than the renewal of the NRC site-specific license. Louisa County, Virginia issued a Conditional Use Permit (CUP) for the North Anna ISFSI which was most recently renewed in 2012 for a seven-year period. Table E1-2 lists the authorizations and consultations necessary for the North Anna site-specific ISFSI license renewal. This section discusses the consultations in more detail.

Table E1-2 Environmental Authorizations for North Anna ISFSI License Renewal

Agency	Authority	Requirements	Remarks
NRC	Atomic Energy Act	ISFSI License Renewal	ER Supplement submitted in support of license renewal application
U.S. Fish and Wildlife Service (USFWS)	Endangered Species Act Section 7 (16 USC 1536)	Consultation	Requires Federal agency issuing license to consult with USFWS regarding federally protected species
Virginia Department of Historic Resources	National Historic Preservation Act Section 106 (16 USC 470f)	Consultation	Requires Federal agency issuing a license to consider cultural impacts and consult with State Historic Preservation Officer (SHPO)
Louisa County, Virginia	Louisa County Zoning Ordinances	Conditional Use Permit for operation of a spent nuclear fuel storage facility	Addresses Pad 1 and Pad 2 and common facilities associated with the ISFSI. Most recently renewed in 2012 for a seven-year period. To be renewed in 2019.

E1.4.1 Threatened and Endangered Species Consultation

Section 7 of the Endangered Species Act (16 USC 1531 et seq.) requires federal agencies to ensure that their actions are not likely to jeopardize the continued existence of species that are listed, or proposed for listing, as endangered or threatened. Depending on the action involved, the Act requires consultation with the USFWS regarding effects on terrestrial and freshwater species, and with the National Marine Fisheries Service (NMFS) regarding effects on anadromous and marine species. USFWS and NMFS have issued joint procedural regulations at 50 CFR Part 402, Subpart B, that address consultation, and USFWS maintains the joint list of threatened or endangered species at 50 CFR Part 17.

The NRC may choose to consult with USFWS to ensure the proposed action will not jeopardize the continued existence of any threatened or endangered species. Because continued operation of the North Anna ISFSI would not affect any listed anadromous or marine species, contact with NMFS is not required. The NRC may choose to solicit comments from the Virginia Department of Game and Inland Fisheries or the Virginia Marine Resources Commission prior to renewing the ISFSI license.

Dominion maintains on-going consultations with USFWS, Virginia Department of Game and Inland Fisheries, and the Virginia Marine Resources Commission as necessary to ensure awareness and compliance with laws and regulations.

E1.4.2 Historic Preservation Consultation

Section 106 of the National Historic Preservation Act (16 USC 470 et seq.) requires federal agencies having the authority to license any undertaking to consider the effect of the undertaking on historic properties and to afford the Advisory Council on Historic Preservation an opportunity to comment on the undertaking, prior to the agency issuing the license. Advisory Council regulations provide for the State Historic Preservation Officer (SHPO) to have a consulting role (35 CFR 800.2).

The Virginia State Archaeologist surveyed the entire NAPS site prior to construction of the station and found no artifacts of archaeological importance (Reference E9.12). The Virginia Historic Landmarks Commission, consulted by Atomic Energy Commission (AEC) staff during preparation of the Final Environmental Statement for construction and operation of Units 1 and 2, reported that no historically significant sites or structures occurred in the project area (Reference E9.12).

Nonetheless, the NRC may request comments from the Virginia SHPO while conducting its environmental review of the proposed action. Dominion maintains on-going contact with the Virginia SHPO as necessary to ensure awareness and compliance with laws and regulations.

E2.0 Alternatives

E2.1 No-Action Alternative

Under the no-action alternative, the North Anna ISFSI specific license, SNM-2507, would expire on June 30, 2018. Accordingly, if SNM-2507 is not renewed, Dominion could not add additional casks to ISFSI Pad 1 under the specific license, but the expired license would continue in effect, pursuant to 10 CFR 72.54(c), and Dominion would continue to possess the licensed material on ISFSI reinforced concrete pad No. 1 until the Commission terminates the license. Additional spent fuel from the continued operation of NAPS would be added to the ISFSI under the general license. Any additional construction or operation impacts associated with the general license would be similar to the environmental impacts of the proposed action, presented in Section E4.0.

Decommissioning of the ISFSI would commence upon NRC approval of the final decommissioning plan in accordance with 10 CFR 72.54. The impacts of decommissioning the ISFSI were evaluated in the original ISFSI license application Environmental Assessment (Reference E9.7, Section 8.0).

E2.2 Other Alternatives

In the original ISFSI license application ER (Reference E9.6, Section 10), Dominion evaluated the following alternatives to constructing the NAPS ISFSI in addition to the no-action alternative:

- Re-racking
- Spent fuel consolidation
- Reducing the rate of spent fuel generation
- Construction of a new spent fuel pool
- Expansion of the existing spent fuel pool
- Shipment to Surry Power Station ISFSI

The NAPS spent fuel pool already uses high density fuel racks so expanding storage capacity through another re-racking is not possible with acceptable safety margins. Consistent with the original ISFSI ER, spent fuel consolidation and reducing spent fuel generation by increasing fuel burnup are not viable options, as the benefit to spent fuel storage capacity is already limited. Reducing the rate of spent fuel generation by reducing power generation would not support Virginia's need for power and Dominion's obligation to provide that power, and is therefore deemed unacceptable.

Of the alternatives originally considered, only construction of a new fuel pool, expansion of the existing fuel pool, or shipment of spent fuel to the Surry ISFSI are potentially viable options to the proposed action.

The remaining three alternatives from the original ISFSI ER and three new alternatives are discussed in the following sections.

E2.2.1 Increase capacity of NAPS spent fuel pool

Storage capacity could be increased through construction of a new spent fuel pool or expansion of the existing spent fuel pool. As described in the original ISFSI license application ER, both options have high costs and would require substantial time (estimated at 10 years) to design, license, and construct (Reference E9.6). Additional operational and environmental impacts would still result with either option to increase spent fuel pool capacity; thus, the original analysis remains relevant and accurate. For these reasons, these alternatives are not reasonable alternatives to extending the specific license for the ISFSI.

E2.2.2 Ship fuel to the Surry ISFSI

This alternative involves shipping spent fuel from the North Anna ISFSI to the Surry Power Station for storage at its ISFSI. While the TN-32 dry storage casks are authorized for storage at the Surry ISFSI, these casks are not approved for transportation. Dominion would have to transfer the spent fuel assemblies from the ISFSI to the North Anna spent fuel pool, and then into other licensed casks for shipment. Shipments could be made in dual-purpose (transport and storage) casks, and these casks would then be stored at the Surry ISFSI. The dual-purpose casks would be shipped to Surry by rail and barge.

Due to the limited storage capacity of the Surry ISFSI, additional construction would be required to accommodate additional spent fuel from North Anna. This alternative would involve amendment of the Surry ISFSI license to allow storage of spent fuel from North Anna and to expand the size of the Surry ISFSI. Based on the higher cost associated with potential repackaging and shipment of the spent fuel, and the additional occupational and non-occupational radiation exposure during handling and transport of the spent fuel, and impacts of constructing additional storage capacity at Surry, this alternative offers no environmental benefits relative to continued storage at the North Anna ISFSI over the period of extended operation. Transfer of the spent fuel for storage at the Surry ISFSI is, therefore, deemed not a reasonable alternative.

E2.2.3 Transfer fuel to the North Anna general license ISFSI

This new alternative was not considered in the original license application. Dominion operates reinforced concrete pad No. 2 under a general license for storage of spent fuel in NUHOMS HD-32PTH dry shielded canisters. Transfer of spent fuel to the general license ISFSI would require the TN-32 dry storage casks be returned to the Fuel and Decontamination Buildings where the spent fuel would be transferred to NUHOMS canisters, which would also necessitate a second concrete storage pad under the general license. The repackaging of the spent fuel and cask decontamination would increase occupational doses beyond those associated with the maintenance of the casks sited on the specific-license ISFSI. Alternatively, Dominion could pursue the necessary regulatory actions to store the existing TN-32 dry storage casks under the general license, which would reduce some of the impacts from repackaging and decontamination, but would not remove the need for another concrete storage pad. This alternative offers no environmental benefits relative to the ISFSI license renewal.

E2.2.4 Ship fuel to an offsite interim storage facility

This new alternative was not considered in the original license application. Commercial entities have expressed interest in establishing a consolidated interim storage facility (CISF) for away-from-reactor storage of spent nuclear fuel. Two locations in the southwestern U.S., the Eddy-Lea Alliance facility in New Mexico (Reference E9.13) and the Waste Control Specialists facility in Andrews County, Texas (Reference E9.14), have been proposed. Waste Control Specialists (in April 2016) submitted its CISF application to the NRC and the Eddy-Lea Alliance facility is in the pre-application stage. Both entities have identified acceptance of spent fuel from "stranded" sites [ISFSIs at shutdown reactor sites (Reference E9.15)] as a priority. Because the availability of a CISF for NAPS spent fuel is unlikely in time (by 2018) to eliminate the need for the NAPS ISFSI license renewal, shipment of the spent fuel to an offsite facility is not a reasonable alternative.

E2.2.5 Ship fuel to a permanent federal repository

This new alternative was not considered in the original license application. Dominion and NRC intend for storage at the ISFSI to be interim pending availability of a federal repository. There is uncertainty regarding when a federal repository will be licensed and the schedule under which it will be available to accept spent fuel shipments impacts the necessity for NAPS ISFSI site-specific license renewal. The repository schedule drives the ISFSI duration; the longer it takes for the repository to begin accepting spent fuel shipments, the longer the ISFSI must store spent fuel.

In response to recommendations by the Blue Ribbon Commission on America's Nuclear Future (Reference E9.15), the U.S. Department of Energy (DOE) identified a strategy to implement storage capabilities within the next 10 years and to engage in a consent-based siting process and begin to conduct preliminary site investigations for a geologic repository (Reference E9.16). DOE's stated goal is to have a repository sited by 2026; the site characterized, the repository designed and licensed by 2042; and the repository constructed and operational by 2048 (Reference E9.16). The earliest that DOE anticipates availability of a geologic repository to accept spent nuclear fuel is the year 2048. Since the current license expires in 2018, shipment of NAPS spent fuel to a permanent federal repository is not a viable alternative to the ISFSI license renewal.

E3.0 Affected Environment

E3.1 Site Location

NAPS is located in Louisa County, Virginia, on a peninsula on the southern shore of Lake Anna, which was created on the North Anna River to provide cooling water for the station. The largest community within 10 miles of the site is the town of Mineral (Louisa County), approximately six miles west-southwest of the site. The community of Louisa is approximately 12 miles west of the site. The site is approximately 40 miles north-northwest of Richmond; 36 miles east of Charlottesville; 22 miles southwest of Fredericksburg; and 70 miles southwest of Washington, D.C. Interstate highways 95 and 64 are 16 miles east and 16 miles southwest of the site, respectively.

NAPS was originally designed to support four nuclear units, though only two were built. Dominion has a Combined Operating License Application (COLA) before NRC, proposing to construct and operate a third nuclear unit, designated Unit 3. The new reactor would be west of the existing Units 1 and 2 as shown on Figure E3-1 (Reference E9.10).

The ISFSI is approximately 2,000 feet southwest of the NAPS Units 1 and 2 Protected Area and within the boundaries of the North Anna site (see Figure E3-1). The North Anna site comprises 1,803 acres, of which approximately 760 acres are covered by water (parts of North Anna Reservoir and the Waste Heat Treatment Facility [WHTF]). The ISFSI area is approximately 11 acres.

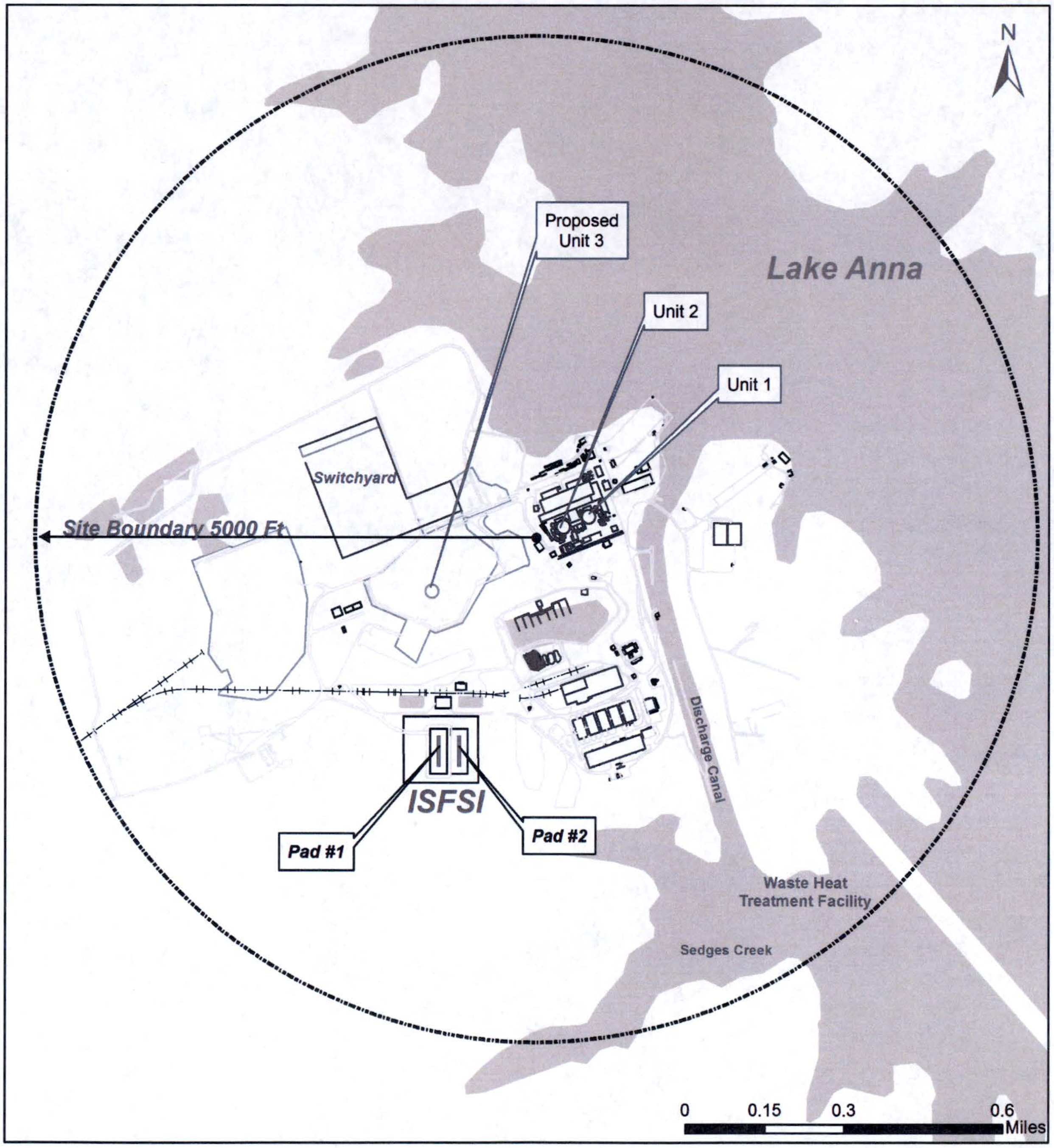
The following descriptions provide information on specific resource areas that could be impacted by the continued operation of the NAPS ISFSI.

E3.2 Land Use

Dominion controls all the land within the site boundary, including those portions of Lake Anna that lie within the site boundary. NAPS is zoned industrial. A mesic mixed hardwood forest covers most of the NAPS peninsula (Figure E3-2). Approximately 20 percent of the site is used for NAPS facilities, and another 10 percent is cleared (Reference E9.8, Section 2.2.1.1). With the exception of the proposed development of Unit 3, the site land use is consistent with the discussion in the original ISFSI license environmental assessment (Reference E9.7, Section 4.3).

The topography in the site region is characteristic of the central Piedmont Plateau with a gently undulating surface varying from 200 to 500 feet above sea level. The surrounding region is forested with occasional farms. The land adjacent to Lake Anna is increasingly residential.

Figure E3-1 North Anna Site Layout



Adapted from Reference E9.10, Figure 1.1-1

Figure E3-2 View of ISFSI (Looking North)

E3.3 Transportation

Road access to NAPS is via State Route 700, which intersects State Route 652 approximately one-half mile from the site. The major commuting routes in the immediate vicinity of NAPS are State Routes 700, 652, 208, 618, and U.S. Route 522. These roads all have level of service (LOS) designation B which means a stable traffic flow with the freedom to select speed but slightly diminished maneuverability. The intersection of State Route 606 and I-95 is congested with a LOS of D (high-density, stable flow in which the freedom to maneuver is severely restricted; some increases in traffic could generally cause operational problems) or better. General transportation studies have been undertaken of highways in the region and plans are in place to upgrade several highways, including those in areas around Lake Anna, as funds are available. Additional detail is provided in Section 2.8.2.2 of the ESP EIS, NUREG-1811, and in Section 2.8.2.2 of the COLA Supplemental EIS, NUREG-1917. (Reference E9.9, Reference E9.11)

E3.4 Geology, Soils, and Seismology

NAPS is within the Piedmont Physiographic Province, which is characterized by an undulating, rolling topography with as much as 100 feet of relief in the general site area (Reference E9.17, Section 2.5.1.1). The Central and Eastern United States Seismic Source Characterization host seismotectonic source for the NAPS site is the Extended Continental Crust-Atlantic Margin Zone, which includes the region characterized by the presence of extended continental crust developed during Mesozoic rifting along the Atlantic Ocean basin margin (Reference E9.18). Two areas of elevated seismic activity occur within 200 miles of the site. These seismically active areas consist of the Central Virginia seismic zone (CVSZ) and the Giles County seismic zone. NAPS lies within the CVSZ. Seven bedrock faults of Paleozoic age have been mapped within five miles of the site. The next closest fault is near Mineral, Virginia, six miles west of the site. The CVSZ is an area of persistent, low-level seismicity (Reference E9.8). The ISFSI Safety Analysis Report (SAR) (Reference E9.17, Section 2.5) and the ESP application ER (Reference E9.8) and COLA ER (Reference E9.10) provide detailed information on geology, soils, and, seismology of the area.

On August 23, 2011, an M 5.8 earthquake occurred near Mineral, Virginia, approximately 11 miles from the site. The Mineral, Virginia earthquake was the strongest recorded seismic event in the CVSZ, surpassing an earthquake that occurred in Goochland County, Virginia in 1875, that had an estimated magnitude of M 4.8 based on felt reports and damage. The strongest known earthquake to occur in the Giles County seismic zone was the May 31, 1897 M 5.9 Giles County event (Reference E9.10).

E3.5 Water Resources

The North Anna Reservoir and the WHTF comprise 13,000 acres (Reference E9.6). The WHTF is a 3,400-acre facility separated from the North Anna Reservoir by a series of dikes. It receives the discharge from the NAPS once-through cooling systems (Reference E9.19, Section 3.1.2). Precipitation runoff in the vicinity of the ISFSI would drain west to a tributary to Sedges Creek, which drains to the WHTF.

As described in Section 2.4.10.1 of the ISFSI SAR (Reference E9.17), groundwater below the ISFSI site moves towards the tributary directly south of the ISFSI, and eventually to the Sedges Creek arm of the WHTF. Groundwater provides the potable water for NAPS. The closest groundwater production well to the ISFSI site is approximately 1,500 feet to the west, near the North Anna Nuclear Information Center. The closest offsite residential well to the ISFSI site is approximately 3,500 feet to the south. (Reference E9.17, Section 2.4.10.2)

Dominion samples shallow groundwater monitoring wells on the North Anna site. Several of these monitoring wells are adjacent to the ISFSI. Analyses of these samples for radionuclides have not identified concentrations in excess of the respective minimum detectable concentrations.

E3.6 Ecological Resources

E3.6.1 Natural Communities

The area of potential ecological impact for continued operations of the ISFSI is the area immediately surrounding the ISFSI. That area would be disturbed by noise associated with the infrequent transfer of storage casks from the NAPS fuel pool to the ISFSI. The discussion that follows focuses on terrestrial resources, and specifically wildlife, in the general vicinity of the ISFSI.

The areas north and east of the ISFSI have been altered by industrial development (Figure E3-1). A state access road borders the ISFSI to the north, and beyond the road is a flat, grassy area used for equipment storage. Parking lots lie approximately 400 feet east of the ISFSI, with a warehouse complex beyond the parking lots. A narrow forested strip is immediately east of the ISFSI, but any value these woods have as wildlife habitat is reduced by their proximity to the parking lots and warehouses. Several hundred acres of hardwood forest south of the ISFSI provide habitat for common songbirds, e.g., blue jay, Northern cardinal, Carolina chickadee, and mammals, e.g., gray squirrel, raccoon, white-tailed deer (Reference E9.8, Reference E9.9). The area to the west between the North Anna Nuclear Information Center and the ISFSI is a mixed forest bisected by a 150-foot-wide transmission corridor.

E3.6.2 Special-Status Species

No protected species has been observed in the vicinity of the ISFSI by NAPS environmental personnel. Bald eagles, protected under the Bald and Golden Eagle Protection Act, forage around Lake Anna, and one bald eagle was observed nesting on a transmission tower adjacent to the NAPS switchyard in 2015. This nest is greater than 660 feet from the ISFSI (a buffer typically required by National bald eagle guidelines). State-threatened loggerhead shrikes have been seen in the vicinity, but no breeding pairs have been observed (Reference E9.8, Reference E9.9). Table E3-1 lists protected species from the Virginia Department of Game and Inland Fisheries, recorded in Louisa County (for a three-mile radius around the ISFSI location) (Reference E9.20).

E3.7 Meteorology, Climatology and Air Quality

The regional climate of the NAPS site is that of the Piedmont region of Virginia, which is classified as modified continental. Summers are warm and humid and winters are generally mild. The Blue Ridge Mountains to the west act as a partial barrier to outbreaks of cold, continental air in winter. The mountains also tend to channel winds along a general north-south orientation. Temperatures in the site region rarely exceed 100°F or fall below 0°F (Reference E9.9). Additional detail on the meteorology and climate of the North Anna site is provided in the ESP EIS, Section 2.3.1 (Reference E9.8). NAPS is in the Northeastern Virginia Intrastate Air Quality Control Region (AQCR) (40 CFR 81.144). This AQCR is in attainment or unclassified for all criteria pollutants (40 CFR 81.347).

Table E3-1 Special-Status Species Recorded from Louisa County

Scientific Name	Common Name	Federal Status	State Status
Myotis septentrionalis	Northern long-eared bat	FT	
Bartramia longicauda	Upland sandpiper		ST
Haliaeetus leucocephalus	Bald eagle	FS	
Lanius ludovicianus	Loggerhead shrike		ST
Lanius ludovicianus migrans	Migrant loggerhead shrike		ST
Alosa aestivalis	Blueback herring	FS	
Alasmidonta heterodon	Dwarf wedgemussel	FE	SE
Elliptio lanceolata	Yellow lance	FS	
Lasmigona subviridis	Green Floater		ST
Speyeria idalia idalia	Regal Fritillary	FS	

*FE = Federal endangered; FT = Federal threatened; FS = Federal species of concern; SE = State endangered; ST = State threatened

Source: Reference E9.20

E3.8 Noise

The ESP EIS Section 2.8.2.4 states that noise from plant operations (which would include current ISFSI operations) is not noticeable from points outside the plant boundary (Reference E9.9). Furthermore, Section 5.4.1.2 of the ESP EIS states that current noise levels are occasionally as high as 100 decibels (measured at the security fence during outages), but they are typically less than 80 to 85 decibels (Reference E9.9). The COLA Supplemental EIS, Section 2.8.2.4, adds that there have been no noise complaints filed from the public regarding operation of Units 1 and 2 (including the ISFSI) (Reference E9.11).

E3.9 Historical and Cultural Resources

The Virginia State Archaeologist surveyed the entire NAPS site, including the area that was to become Lake Anna, prior to construction of the station. No artifacts of archaeological importance were found (Reference E9.12, p. 2-12 and Appendix 2.1). The Virginia Historic Landmarks Commission, consulted by Atomic Energy Commission (AEC) staff during preparation of the Final Environmental Statement for construction and operation of NAPS Units 1 and 2, reported that no historically significant sites or structures had been identified in the project area (Reference E9.12, p 2-12). In addition, the entire NAPS site was evaluated further for historical and cultural resources impacts to support plant license renewal and combined license application proceedings, respectively, and NRC acknowledged Dominion process controls in place were to be executed should inadvertent discovery of resources occur (Reference E9.29 and Reference E9.11).

E3.10 Visual and Scenic Resources

The ISFSI occupies a cleared, graded area on the southeast edge of the developed portion of the North Anna site (Figure E3-1). The vertical storage casks (approximately 17 feet in height) and security fences are the facility's dominant visual features. The ISFSI is surrounded by mixed pine-hardwood (mostly hardwood) forests to the west, south, and east. The ISFSI is not visible from off-site roads, nearby residences, or recreational users of Lake Anna, due to topography and other natural and site obstructions.

E3.11 Demography and Socioeconomics

E3.11.1 Demography

The original ISFSI ER provides the population distribution of permanent residents from 2000 through 2030, based on 1990 census data and population growth projections, for selected concentric rings between 1 mile and 50 miles around the plant (Reference E9.6). Dominion updated this information in the ESP application ER which provides population distribution of combined residents and transients from 2010 through 2065, based on 2000 census data and population growth projections, using a similar grid (Reference E9.8). This updated population distribution covers the term of the proposed ISFSI license renewal and is provided in Table E3-2 through Table E3-7. Figures 2.5-3 through 2.5-12A of the ESP application ER illustrate the locations of the sectors associated with these population estimates (Reference E9.8). Dominion completed an internal new and significant sensitivity analysis in connection with the pending North Anna 3 COLA after the 2010 Census data were made available and concluded the changes in population would not change the evaluation of offsite population doses for the proposed Unit 3. With offsite dose contribution from ISFSI operations less than plant operations, the impact conclusion of SMALL would be the same.

As described in Section E4.0, the ISFSI potentially affects the workforce and local population through external radiation exposure, and thus, only potentially affects people near the ISFSI. The population distribution nearest the site is therefore the most important. There is a 5,000-foot-radius exclusion area boundary around the center of the NAPS site (Figure E3-1). The ISFSI SAR states that in 2000, there were an estimated 354 residents within 2 miles of the site boundary. The site boundary and the exclusion area boundary are regarded the same (transients were considered in the ESP population analysis, for which data are provided in this report, however, only residents are considered in the current analysis). This population could be expected to increase over the life of the renewed license in accordance with growth rates published in the ESP application ER (Reference E9.8). The nearest permanent residence is 2,860 feet from the ISFSI (Reference E9.17, Section 7.5).

E3.11.2 Environmental Justice

The geographic distribution of minority and low-income populations near the ISFSI site was not addressed in the initial ISFSI licensing ER. Dominion addressed the geographic distribution of minority and low-income populations within a 50-mile radius of NAPS as part of the renewal of the Units 1 and 2 operating licenses (Reference E9.19, Section 2.11) and the ESP application ER (Reference E9.8, Section 2.5.4). Based on NRC guidance in Appendix D of LIC-203 (Reference E9.21) for performing environmental justice reviews, Dominion identified the locations of predominantly minority and low-income population census tracts and considered whether those populations would suffer potential disproportionately high and adverse impacts by the operation of Units 1 and 2 or the proposed future construction and operation of Unit 3.

As described in Section 2.5.4 of the ESP application ER the closest minority population is a black minority population approximately 12 miles southwest of the NAPS site (Reference E9.8, Figure 2.5-14). Both Richmond and Charlottesville have low-income populations that are more than 36 miles from the site (Reference E9.8, Figure 2.5-15).

E3.11.3 Socioeconomics

The permanent NAPS workforce comprises approximately 850 employees. An additional 700 to 1000 workers are onsite during planned outages (Reference E9.8, Section 2.5.2). Approximately 500 new employees would be required for the operation of the proposed Unit 3 (Reference E9.10, Table 3.0-2). ISFSI operations require no full-time staff. All ISFSI activities are performed by current NAPS employees and part-time supplemental employees. No additional employees beyond current operational support would be required for ISFSI operations during the period of extended operation.

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Table E3-2 Estimated Population Distribution in 2000 within 50 miles of North Anna Site

Sector	0-1.24 mi	1.24-2.5mi	2.5-3.73 mi	3.73-5.0 mi	5.0-6.2 mi	6.2-10.0 mi	10-24.9 mi	24.9 - 37.3 mi	37.3 - 50 mi
N	0	823	115	137	233	240	9,251	11,506	31,647
NNE	18	1,206	17	120	156	785	13,449	32,315	126,778
NE	2	9	240	171	130	719	76,397	58,229	57,315
ENE	0	34	73	23	0	1,313	12,460	8,380	17,511
E	0	906	45	46	145	679	7,853	2,134	4,456
ESE	0	15	171	189	71	668	7,105	4,640	9,449
SE	59	189	73	97	249	459	5,214	46,504	65,437
SSE	96	70	109	127	178	685	7,762	213,500	368,445
S	117	61	181	71	114	465	6,340	16,883	46,152
SSW	59	94	59	232	24	300	6,122	6,202	7,085
SW	10	29	12	0	134	920	3,134	3,594	5,839
WSW	0	13	62	116	308	828	5,823	15,018	8,216
W	81	112	2	44	135	259	4,449	32,561	76,069
WNW	0	91	161	48	1,035	259	6,715	13,478	11,350
NW	0	583	219	49	388	887	7,314	9,797	3,192
NNW	4	877	91	4,730	17	605	6,068	21,451	10,406

Source: Reference E9.8, Figures 2.5-3 and 2.5-8.

Table E3-3 Estimated Population Distribution in 2010 within 50 miles of North Anna Site

Sector	0-1.24 mi	1.24-2.5mi	2.5-3.73 mi	3.73-5.0 mi	5.0-6.2 mi	6.2-10.0 mi	10-24.9 mi	24.9 - 37.3 mi	37.3 - 50 mi
N	0	1,197	167	199	339	349	11,435	13,014	35,717
NNE	26	1,754	25	174	227	1,141	19,513	44,639	159,959
NE	3	13	349	249	189	1,045	101,027	82,114	71,957
ENE	0	49	106	33	0	1,909	17,627	10,144	20,287
E	0	1,317	65	67	211	987	9,205	2,429	5,003
ESE	0	22	249	275	103	950	8,106	5,354	10,789
SE	59	219	76	106	293	588	6,828	57,823	81,837
SSE	105	73	121	143	206	847	10,149	250,053	400,219
S	130	61	209	74	140	573	7,881	21,923	57,148
SSW	59	102	59	286	30	370	7,342	7,847	8,846
SW	12	36	15	0	165	1,133	3,862	4,882	7,003
WSW	0	16	76	143	379	1,020	7,419	21,685	10,134
W	100	138	2	54	166	319	5,478	37,213	85,863
WNW	0	112	198	59	1,275	346	8,040	17,238	14,682
NW	0	718	270	67	564	1,270	8,652	10,507	3,385
NNW	5	1,275	132	6,878	25	880	7,248	25,941	11,816

Source: Reference E9.8, Figures 2.5-4 and 2.5-9.

Table E3-4 Estimated Population Distribution in 2020 within 50 miles of North Anna Site

Sector	0-1.24 mi	1.24-2.5mi	2.5-3.73 mi	3.73-5.0 mi	5.0-6.2 mi	6.2-10.0 mi	10-24.9 mi	24.9 - 37.3 mi	37.3 - 50 mi
N	0	1,570	219	261	445	458	13,618	14,522	39,787
NNE	34	2,301	32	229	298	1,498	25,577	56,962	193,139
NE	4	17	458	326	248	1,372	125,658	105,998	86,600
ENE	0	65	139	44	0	2,505	22,793	11,908	23,064
E	0	1,729	86	88	277	1,296	10,557	2,724	5,550
ESE	0	29	326	361	135	1,231	9,108	6,069	12,130
SE	59	249	79	115	337	717	8,442	69,141	98,238
SSE	113	75	132	159	233	1,008	12,537	286,605	431,993
S	144	62	238	77	167	681	9,421	26,962	68,144
SSW	59	110	59	340	35	439	8,563	9,491	10,607
SW	15	42	18	0	196	1,347	4,591	6,170	8,168
WSW	0	19	91	170	451	1,212	9,016	28,352	12,051
W	119	164	3	64	198	379	6,507	41,864	95,656
WNW	0	133	236	70	1,515	433	9,366	20,999	18,013
NW	0	853	321	86	740	1,654	9,989	11,218	3,578
NNW	6	1,673	174	9,026	32	1,154	8,428	30,431	13,225

Source: Reference E9.8, Figures 2.5-5 and 2.5-10.

Table E3-5 Estimated Population Distribution in 2030 within 50 miles of North Anna Site

Sector	0-1.24 mi	1.24-2.5mi	2.5-3.73 mi	3.73-5.0 mi	5.0-6.2 mi	6.2-10.0 mi	10-24.9 mi	24.9 - 37.3 mi	37.3 - 50 mi
N	0	1,944	272	324	550	567	15,802	16,030	43,856
NNE	43	2,849	40	283	369	1,854	31,641	69,286	226,320
NE	5	21	567	404	307	1,698	150,288	129,883	101,242
ENE	0	80	172	54	0	3,102	27,960	13,672	25,840
E	0	2,140	106	109	343	1,604	11,910	3,020	6,097
ESE	0	35	404	446	168	1,513	10,109	6,783	13,470
SE	59	279	83	123	381	846	10,055	80,460	114,638
SSE	122	78	144	174	261	1,170	14,924	323,158	463,767
S	157	62	266	79	193	788	10,962	32,002	79,140
SSW	59	118	59	393	41	509	9,783	11,136	12,368
SW	17	49	20	0	227	1,560	5,319	7,458	9,332
WSW	0	22	105	197	522	1,404	10,612	35,018	13,969
W	137	190	3	75	229	439	7,536	46,516	105,450
WNW	0	154	273	81	1,755	520	10,691	24,759	21,345
NW	0	988	371	104	917	2,037	11,327	11,928	3,772
NNW	7	2,072	215	11,174	40	1,429	9,607	34,922	14,635

Source: Reference E9.8, Figures 2.5-6 and 2.5-11.

Table E3-6 Estimated Population Distribution in 2040 within 50 miles of North Anna Site

Sector	0-1.24 mi	1.24-2.5mi	2.5-3.73 mi	3.73-5.0 mi	5.0-6.2 mi	6.2-10.0 mi	10-24.9 mi	24.9 - 37.3 mi	37.3 - 50 mi
N	0	2,318	324	386	656	676	17,985	17,537	47,926
NNE	51	3,397	48	338	439	2,211	37,704	81,610	259,500
NE	6	25	676	482	366	2,025	174,918	153,768	115,885
ENE	0	96	206	65	0	3,698	33,126	15,436	28,616
E	0	2,552	127	130	408	1,912	13,262	3,315	6,644
ESE	0	42	482	532	200	1,794	11,111	7,498	14,811
SE	59	310	86	132	425	976	11,669	91,779	131,038
SSE	130	80	155	190	288	1,332	17,312	359,710	495,541
S	171	63	294	82	220	896	12,503	37,042	90,136
SSW	59	126	59	447	46	578	11,003	12,780	14,130
SW	19	56	23	0	258	1,773	6,047	8,746	10,496
WSW	0	25	119	224	594	1,596	12,208	41,685	15,886
W	156	216	4	85	260	499	8,565	51,167	115,244
WNW	0	175	310	93	1,995	607	12,017	28,519	24,676
NW	0	1,124	422	123	1,093	2,420	12,665	12,638	3,965
NNW	8	2,470	256	13,321	48	1,704	10,787	39,412	16,044

Source: Reference E9.8, Figures 2.5-7 and 2.5-12

Table E3-7 Estimated Population Distribution in 2065 within 50 miles of North Anna Site

Sector	0-1.24 mi	1.24-2.5mi	2.5-3.73 mi	3.73-5.0 mi	5.0-6.2 mi	6.2-10.0 mi	10-24.9 mi	24.9 - 37.3 mi	37.3 - 50 mi
N	0	3,252	454	541	921	948	23,444	21,307	58,101
NNE	71	4,766	67	474	616	3,102	52,863	112,419	342,452
NE	8	36	948	676	514	2,841	236,494	213,480	152,491
ENE	0	134	288	91	0	5,188	46,043	19,847	35,557
E	0	3,580	178	182	573	2,683	16,642	4,053	8,012
ESE	0	59	676	747	281	2,498	13,614	9,284	18,162
SE	59	385	94	154	535	1,299	15,704	120,075	172,039
SSE	152	87	184	229	357	1,736	23,281	451,091	574,975
S	204	64	365	89	286	1,166	16,354	49,641	117,626
SSW	59	147	59	582	60	752	14,054	16,891	18,532
SW	25	73	30	0	336	2,306	7,868	11,966	13,407
WSW	0	33	155	291	772	2,076	16,199	58,352	20,680
W	203	281	5	110	338	649	11,137	62,796	139,728
WNW	0	228	404	120	2,594	824	15,330	37,920	33,005
NW	0	1,461	549	169	1,533	3,378	16,009	14,414	4,448
NNW	10	3,466	360	18,691	67	2,391	13,737	50,637	19,568

Source: Reference E9.8, Figures 2.5-7A and 2.5-12A.

E4.0 Environmental Impacts

The following sections primarily address environmental consequences associated with continued operations of the North Anna ISFSI. Dominion also considered the potential cumulative impacts of ISFSI continued operations with NAPS Units 1 and 2 operations and the reasonably foreseeable future action of construction and operation of the proposed Unit 3. Dominion considered the specific resource areas that may have potential impacts associated with the ISFSI operations over the extended license term.

On September 19, 2014, the NRC published a revised rule in 10 CFR 51.23, "Environmental Impacts of Continued Storage of Spent Nuclear Fuel Beyond the Licensed Life for Operations of a Reactor" (the "Continued Storage Rule") (Reference E9.22). The NRC rule codifies the generic impact determinations in NUREG-2157, Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel (Reference E9.23). Formerly known as the Waste Confidence Decision and Rule, the revised rule adopts the generic impact determinations made in NUREG-2157 and codifies NRC's generic determinations regarding the environmental impacts of continued storage of spent fuel beyond a reactor's operating license, i.e., those impacts that could occur as a result of the storage of spent fuel at a reactor or away-from-reactor sites between the time a reactor's licensed operation ends and a permanent repository becomes available. The updated Continued Storage Rule and NUREG-2157 provide the National Environmental Policy Act analyses of human health and environmental impacts of continued storage of spent fuel beyond the licensed life of a reactor that are needed to support renewal of the North Anna ISFSI license.

The analysis in NUREG-2157 concluded that the potential impacts of at-reactor storage during the short-term time frame (no more than 60 years after the expiration of the reactor's license to operate) would be SMALL (Reference E9.23, Section 4.20). Further, the analysis in NUREG-2157 stated that disposal of the spent fuel in a DOE repository by the end of the short-term time frame is the most likely outcome (Reference E9.23, Section 1.2). As described in the following sections, impacts from the proposed renewal of SNM-2507 are primarily occupational and public health impacts associated with radiological exposure. Cumulative impacts would occur if multiple sources for radiological exposure affect the same population.

E4.1 Impacts from Refurbishment and Construction

There are no current plans to expand the pad capacity under the specific license beyond reinforced concrete pad No. 1, but Dominion and ODEC retain the authority to do so under the terms of the NAPS specific ISFSI license. Construction of up to three pads at the North Anna ISFSI was addressed in the original licensing evaluation (Reference E9.7, Chapter 4).

As described in Section E1.2.2, no refurbishment beyond normal maintenance and aging management is planned. Only maintenance, such as re-coating the casks, is expected over the proposed 40-year period of extended operation. Subsequently, there are no environmental impacts from refurbishment or construction beyond those analyzed in the original environmental assessment (Reference E9.7, Section 6.0).

E4.2 Occupational and Public Radiological Health Impacts

No liquid or gaseous effluents are released to the environment from operation of the ISFSI. Only external radiation from the sealed TN-32 dry storage casks could, therefore, affect workers or members of the public. The design and operational features of the TN-32 dry storage casks, along with the station's radiological protection program, mitigate radiological impacts (Reference E9.17). The ISFSI SAR provides dose calculations that assume that three ISFSI pads are filled with 84 TN-32 dry storage casks, each containing 32 fuel assemblies of representative NAPS low-burnup fuel. While the proposed action includes construction of up to three pads, the space for a second reinforced concrete pad under the specific license is occupied by a separate, general license ISFSI pad. Using the originally planned three ISFSI pads for the analysis provides bounding results for the proposed action. Potential occupational and public ISFSI doses are addressed separately below.

E4.2.1 Occupational Dose

The SAR presents calculations of the following: 1) doses to all NAPS staff exposed to external radiation from the ISFSI; 2) doses to staff loading fuel assemblies into casks, transporting casks to the ISFSI, and placing the casks on the ISFSI pad; and 3) doses to staff performing surveillance and maintenance at the ISFSI.

The calculated annual collective dose is 14.4 person-rem, based on 84 TN-32 dry storage casks (Reference E9.17, Section 7.4). This exposure represents approximately 11 percent of the average annual occupational exposure for all NAPS operations during 2010 through 2012 (Reference E9.24, Table 4.7). Of the calculated 14.4 person-rem per year, approximately 11.1 person-rem per year is from loading, transporting, and placing the casks on the pad (based on four casks per year). The calculation is conservative. Based on actual operating experience, the annual collective dose is much lower, due to the NAPS As Low as Reasonably Achievable (ALARA) program. For example, records show that for the 27 casks currently loaded on reinforced concrete pad No. 1, the average annual collective dose for loading, transporting, and placing the casks was 2.5 person-rem, which is less than 23 percent of that calculated in the SAR (Reference E9.17, Section 7.4). ISFSI Technical Specifications limit individual cask dose rates, thus, limiting any increase in exposure to NAPS staff during the period of extended operation (Reference E9.25, LCO 3.3.1).

E4.2.2 Public Dose

Prior to construction of NAPS, the direct radiation dose rates characteristic of the area ranged from 4.3 to 8.8 millirem per month or approximately 52 to 106 millirem per year (Reference E9.26, Section 4.1). In 2014, the direct radiation dose at a measurement station close to the ISFSI (in the southwest direction) was 4.5 millirem per month or 54 millirem per year (Reference E9.27, Table 3-2). This operational direct radiation value is within the range of the pre-operational background radiation.

The SAR Section 7.5 presents calculation of the annual dose from ISFSI external radiation to the nearest permanent resident as 2.1 millirem per year, which is below the 25 mrem/yr limit imposed by 10 CFR 72.104(a). Using SAR population data (census year 2000), the collective dose is calculated as if all the individuals within 2 miles of the site boundary live at the location of the nearest permanent resident. The resulting collective dose is 0.74 person-rem. The assumption of locating all the residents at the location of the nearest permanent resident is conservative.

E4.2.3 Cumulative Public Dose Impact

During 2014, the calculated dose to the maximally exposed member of the public (a hypothetical construct used in the calculation rather than an actual person) was 0.39 millirem per year from effluents from Units 1 and 2 operation (Reference E9.27, p6). The SAR establishes that the calculated dose to the maximally exposed individual from NAPS Units 1 and 2 operations combined with the ISFSI dose to the nearest resident (2.1 millirem per year) is well below the 25 millirem per year limit of 10 CFR 72.104(a) and 40 CFR 190, "Environmental Radiation Protection Standards for Nuclear Power Operations." The cumulative dose impacts of the ISFSI and Units 1 and 2 operations are SMALL. (The closest nuclear power plant to North Anna, Dominion's Surry Power Station, is approximately 85 miles away, and therefore, does not contribute to the cumulative impact.) While additional cask loading to the NAPS ISFSI is potentially foreseeable, NRC would continue to regulate any future actions that could contribute to cumulative radiological impacts.

In its environmental impact statement for the NAPS early site permit, NRC reviewed historical and estimated population doses and stated doses to the maximally exposed individuals around NAPS were a small fraction of Federal environmental protection standards (Reference E9.9 Section 2.5).

E4.3 Other Operational Impacts

The operation of the ISFSI involves dry storage of spent nuclear fuel in sealed containers. With the exception of cask placement, inspections, and maintenance, storage operation is passive. There are no liquid or gaseous effluents. Accordingly, no impacts are expected other than those from external radiation as described in Section E4.2. NUREG-1748 identifies the types of environmental impacts to be analyzed for a materials license ER (Reference E9.5). Each identified discipline or resource area is briefly addressed below. Conclusions drawn from the original ISFSI environmental assessment are adopted, where available and appropriate, as they are still valid (Reference E9.7, Section 6).

Land Use: The land occupied by the ISFSI was committed when the ISFSI was constructed. It is located within the developed NAPS site area. No additional land use impacts are expected from continued operation beyond those described in the original environmental assessment (Reference E9.7, Section 6.1.1).

Transportation: ISFSI workers are part of the general plant population; no additional employees beyond current operational support are required to manage the ISFSI. No impacts to transportation are expected.

Geology and Soils: Impacts to geology and soils occurred when the ISFSI was constructed. No additional impacts to geology or soils are expected from continued operation beyond those described in the original environmental assessment (Reference E9.7).

Water Resources: The ISFSI does not require water for its operation, and does not discharge effluents to surface water. Because the ISFSI work force is drawn from the general plant population, no additional sanitary waste is generated. No impact to water resources is expected from continued operation beyond those described in the original environmental assessment (Reference E9.7).

Ecological Resources: Any ecological impacts occurred when the ISFSI was constructed. The original environmental assessment asserted that ISFSI operation would have minimal impact on local wildlife (Reference E9.7, Section 6.2.2). Fences provided for other purposes prevent wildlife access to the ISFSI. Weather covers prevent birds from roosting directly on the casks. No ecological impact is expected from continued operation beyond those described in the original environmental assessment (Reference E9.7, Section 6.2.2).

Air Quality: The ISFSI does not release airborne emissions. Transfer of casks to the pads is infrequent and of short duration, resulting in minimal exhaust emissions. No adverse air quality impact is expected from continued operation beyond those described in the original environmental assessment (Reference E9.7).

Noise: The original environmental assessment concluded that the only operational noise associated with the proposed action would occur during the transfer of casks (Reference E9.7, Section 6.2.2). This noise is low in intensity and of short duration, and occurs several times a year. No adverse noise impact is expected from continued operation.

Historical and Cultural Resources: Continued operation does not involve any land disturbance. No historical or cultural resource impact is expected from continued operation beyond those described in the original environmental assessment (Reference E9.7, Section 4.9).

Visual/Scenic Resources: There are no structures at the ISFSI that are visible from off site. Continued operation of the ISFSI, therefore, presents no visual or aesthetic impact on the surrounding area beyond those described in the original environmental assessment (Reference E9.7, Section 4.9).

Socioeconomics: Any changes to the local economy as a result of the construction and operation of the ISFSI occurred when the ISFSI was constructed. There are currently no dedicated ISFSI employees. Following cessation of operations of North Anna Units 1 and 2 and decommissioning, dedicated ISFSI staffing would be bounded by current staffing for Unit 1 and 2 operations. No socioeconomic impacts are, therefore, expected from continued operation beyond those described in the original environmental assessment (Reference E9.7).

Environmental Justice: As described in Section E4.2.3, the cumulative dose impacts of the ISFSI and Units 1 and 2 operations are SMALL. The minority and low-income populations (Section E3.11.2) are located more than 10 miles away from the site, well beyond the range of any public dose effects. There can be no disproportionately high and adverse impacts to minority or low-income populations.

Public and Occupational Health: Public and occupational radiological health is addressed in Section E4.2. As discussed above, ISFSI operations have no effect on non-radiological public health. Non-radiological occupational health effects at NAPS are managed through the site's safety and health program. All work at the ISFSI is performed by general plant workers covered by the NAPS health and safety program. There are no activities at the ISFSI that would pose safety or health hazards different than those found in the general plant environment. No adverse health impact is expected from continued operation.

Radiological Impacts are addressed in Section E4.2.

Waste Management: The original environmental assessment stated that operation of the ISFSI would not result in the generation of gaseous, liquid, or solid radioactive wastes. As described in Section E1.2.2, radioactive waste generated during cask loading operations, which occur in the station Fuel and Decontamination Buildings, is managed as part of normal plant operations. No non-radioactive wastes are associated with the operation of the ISFSI. No additional sanitary or other wastes are generated as a result of the operation of the ISFSI. No waste management impacts are, therefore, expected from continued ISFSI operation.

E4.4 Accident Impacts

NRC regulations at 10 CFR 72.106(b) prescribe dose limits at the nearest boundary of the controlled area from a design basis accident. The SAR for the NAPS ISFSI (Reference E9.17, Section 8.2) examines 10 design basis accidents:

1. Earthquake
2. Extreme Wind
3. Flood
4. Explosion
5. Fire
6. Storage of Unauthorized Fuel Assembly
7. Loss of Neutron Shield
8. Cask Seal Leakage
9. Cask Drop
10. Loss of Confinement Barrier

Five of these accidents, Flood, Storage of Unauthorized Fuel Assembly, Loss of Neutron Shield, Cask Seal Leakage, and Cask Drop are not considered to be credible events (Reference E9.17, Section 8.2).

Three accidents, Extreme Wind, Explosion, and Fire, do not result in the release of radioactive material or in an increase in external radiation dose (Reference E9.17, Section 8.2).

The August 23, 2011 earthquake that occurred near Mineral, Virginia is discussed in Section E4.4.1. The Loss of Confinement Barrier, although not considered credible, has been analyzed and compared against the 10 CFR 72.106(b) criteria. It is discussed in Section E4.4.2.

E4.4.1 Earthquake

Sections 2.5.2.3 and 3.2.3 of the SAR describe the design basis earthquake for the ISFSI as 0.18 g horizontal motion and 0.12 g vertical motion (Reference E9.17). The SAR (Section 8.2.1.2) concludes that the design-basis earthquake is not capable of rupturing the cask seals, releasing radioactivity from the casks, or increasing doses to the workforce or the public.

As described in Section E3.4, on August 23, 2011, an M 5.8 earthquake occurred near Mineral, Virgina, approximately 11 miles from the NAPS site. The earthquake had horizontal ground accelerations at the ISFSI of 0.55 (N-S) and 0.502 (E-W) (Reference E9.3). The earthquake moved 25 of the 27 TN-32 dry storage casks from a nominal separation distance of 16 feet to distances ranging from 15 feet 2.25 inches to 16 feet 11.25 inches (Reference E9.28, p1).

Inspections determined that the integrity of the casks was maintained during the earthquake, despite their movement, and concluded there were no safety issues associated with the movement of the casks. There was also no leakage of radioactive material to the environment from the casks and no increase in external doses (Reference E9.28, p2). See also Section A2.1, Element 10.

E4.4.2 Loss of Confinement Barrier

A loss of confinement barrier involves the simultaneous failure of all of a cask's confinement layers by unspecified means (but not failure of radiation protection or heat removal functions). This hypothetically results in release of radioactive material. The resulting deep dose plus committed dose equivalent to the most limiting organ (bone marrow) is 13 millirem at the nearest site boundary, well below (less than 0.03 percent) the 10 CFR 72.106(b) limit of 50 rem. (Reference E9.17, Section 8.2.10.3)

E5.0 Mitigation Measures

As presented in Chapter E4.0, the only impacts of the proposed action are radiological dose to workers and radiological dose to the public. Workers in the ISFSI wear personnel radiation monitoring devices and dose is recorded and tracked for analysis. External radiation from all sources is continually measured at various places on the North Anna property and in the vicinity of the site. If measured doses exceeded historical levels Dominion would perform analyses to determine the cause and would establish mitigation measures. The NAPS Radiological Protection ALARA program is an effective method for ensuring that doses to workers and the public are as low as can be achieved by reasonable, cost-effective methods. In addition to monitoring the environment around the NAPS site, inspections and maintenance of the dry storage casks are performed to ensure that no degradation of equipment could lead to increased radiation levels.

E6.0 Environmental Measurement and Monitoring

Current monitoring requirements for the ISFSI facility are defined in ISFSI Technical Specification 5.5.2.c and 10 CFR 72.44(d)(3), and are included in the NAPS Radiological Environmental Monitoring Program (REMP). The objectives of the REMP are:

- To provide measurements of radiation and of radioactive materials in those exposure pathways and for those radionuclides that lead to the highest potential radiation exposure of the maximum exposed member of the public resulting from station operations.
- To supplement the radiological effluent monitoring program by verifying that radioactive effluents are within allowable limits.
- To identify changes in radioactivity in the environment.
- To verify that station operations have no detrimental effect on the health and safety of the public.

Details of this program and results can be found in annual radiological environmental operating reports (Reference E9.26).

There are no other physical, chemical, or ecological monitoring requirements beyond those described above to support operations of the ISFSI, explicitly. The proposed action does not involve any changes to the Technical Specifications, refurbishment, or changes in operation that would impact the effectiveness or validity of the REMP. The current monitoring program, therefore, would continue through the period of extended operation, and no additional environmental measurements or monitoring would be required beyond that of the REMP described above.

E7.0 Cost-Benefit

The largest direct benefit of the proposed action, renewal of the ISFSI license for an additional 40 years, is continued storage of spent fuel on reinforced concrete pad No. 1 and maintaining the option to continue to generate electricity by maintaining the capability for safe, secure storage of spent fuel. All of the potential environmental impacts associated with renewing the ISFSI license are SMALL. The incremental increase in operating costs due to aging management activities (primarily cask surveillance and maintenance activities) is inconsequential compared to the cost of expanding the current spent fuel pool, moving the spent fuel to the Surry ISFSI, or transferring the spent fuel to the North Anna general license ISFSI. As explained in Chapter E2.0, these are the only potentially viable alternatives available. But implementing these alternatives also would generate larger adverse environmental impacts than license renewal, including increased occupational radiation exposure and potential public radiation exposure.

Based upon these considerations, the proposed ISFSI license renewal for an additional 40 years of operation would provide economic and environmental advantages over other storage alternatives. The ISFSI license renewal would involve a cost-effective utilization of an existing asset, with SMALL environmental impacts, and making it the preferred means of securing long-term spent fuel storage capability.

E8.0 Summary of Environmental Consequences

E8.1 Unavoidable Adverse Impacts

As presented in Chapter E4.0, the only adverse impacts of the proposed action are radiological dose to workers and radiological dose to the public. Although Dominion employs inspections, maintenance, monitoring, and ALARA principles (Chapter E5.0) to mitigate these impacts, some impact is unavoidable. As indicated in Section E4.2.3, NRC concluded that the cumulative impact of Units 1 and 2, the ISFSI, and the reasonably foreseeable project of Unit 3, remains within the radiation protection standards of 40 CFR 190 (Reference E9.9).

E8.2 Irreversible and Irretrievable Commitment of Resources

The continued operation of the North Anna ISFSI for the license renewal term will result in no additional irreversible and irretrievable resource commitments beyond those materials committed during the initial licensing of the ISFSI, applicable to reinforced concrete pad No. 1, that cannot be recovered or recycled or that are consumed or reduced to unrecoverable forms. As noted in the license application for the ISFSI and NRC's environmental assessment (Reference E9.7, Section 6.1.6), those resources that will be committed to this facility, whether irreversibly or for the life of the facility, represent nominal portions of the total amount of such resources available for use in any particular category. The only resources which will be irretrievably committed as a result of continued ISFSI operations for the license renewal term are the raw materials used for fabrication of dry storage casks. These quantities of raw materials are considered to be modest.

E8.3 Short-Term Uses, Maintenance, and Enhancement of Long-Term Productivity

The current balance between short-term use and long-term productivity of the environment would be unchanged by the renewal of the specific license for the North Anna ISFSI. The ISFSI occupies approximately 11 acres of the existing North Anna site or approximately 1 percent of the total site area. The ISFSI is a temporary storage facility. Once the spent nuclear fuel is moved to a permanent repository, the TN-32 dry storage casks, concrete pads, and fencing could be removed and the land used for another purpose. Renewal of the ISFSI license would postpone restoration of the site and its potential availability for uses other than fuel storage for up to an additional 40 years.

E9.0 References (Appendix E: Environmental Report Supplement)

E9.1 North Anna Power Station Units 1 and 2 Updated Final Safety and Analysis Report. Revision 45. October 1, 2009. ML092820158

E9.2 North Anna Power Station ISFSI Evaluations of Seismic Event on Pad #2 Spent Fuel Storage System. January 24, 2013. ML13037A549

E9.3 North Anna Power Station ISFSI License Amendment Request Regarding Changes to ISFSI Technical Specification 4.2.3, "Storage Pad." May 27, 2014. ML14160A707

E9.4 Materials License No. 2507 for the North Anna Power Station Independent Spent Fuel Storage Installation (TAC NO. L24922). August 3, 2015. ML15050A390

E9.5 Environmental Review Guidance for Licensing Actions Associated with NMSS Programs, NUREG-1748, Office of Nuclear Material Safety and Safeguards, Washington, D.C., August 2003. ML032450279

E9.6 North Anna Power Station Independent Spent Fuel Storage Installation Environmental Report. 1995.

E9.7 Environmental Assessment related to the Construction and Operation of the North Anna Independent Spent Fuel Storage Installation. Docket 72-16. Office of Nuclear Material Safety and Safeguards, Washington, D.C. March 1997. ML123480192

E9.8 North Anna Early Site Permit Application - Part 3 Environmental Report. Revision 9, September 2006. ML062580112 and ML062580114

E9.9 Environmental Impact Statement for an Early Site Permit (ESP) at the North Anna ESP Site, NUREG-1811, Office of New Reactors, Washington, D.C., December 2006. ML063480261

E9.10 North Anna 3 Combined License Application Part 3: Applicants' Environmental Report - Combined License Stage. Revision 7, December 2013. ML14007A643

E9.11 Supplemental Environmental Impact Statement for the Combined License (COL) for North Anna Power Station Unit 3, NUREG-1917, Office of New Reactors, Washington, D.C., February 2010. ML100680117

E9.12 Environmental Statement related to the Continuation of Construction and the Operation of Units 1 & 2 and the Construction of Units 3 & 4 North Anna Power Station. U.S. Atomic Energy Commission. April 1973. ML11143A126

E9.13 Letter from Holtec International to NRC. Notice of Intent to License the ELEA Interim Storage Facility and Request to Establish a New Part 72 Docket. August 3, 2015. ML15215A592

E9.14 Letter from Waste Control Specialists LLC to NRC. Letter of Intent. February 6, 2015. ML15040A687

E9.15 Blue Ribbon Commission on America's Nuclear Future, Transportation and Storage Subcommittee Report to the Full Commission, Updated Report, Washington DC, January 2012.

E9.16 U.S. Department of Energy. Strategy for the Management and Disposal of Used Nuclear Fuel and High-Level Radioactive Waste. January 2013.

E9.17 North Anna Power Station Units 1 & 2 Independent Spent Fuel Storage Installation (ISFSI) Safety Analysis Report. Revision 8. June 2014. ML14233A488

E9.18 Central and Eastern United States Seismic Source Characterization for Nuclear Facilities. NUREG-2115. January 2012. ML12048A804

E9.19 Application for Renewed Operating Licenses, North Anna Power Station Units 1 and 2, Appendix E - Environmental Report. May 29, 2001.

E9.20 Virginia Department of Game and Inland Fisheries, Virginia Fish and Wildlife Information Service (VaFWIS) database. Accessed March 8, 2016. Available on-line at http://vafwis.org/fwis/.

E9.21 Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues. NRR Office Instruction LIC-203, June 21, 2001.

E9.22 10 CFR 51.23, "Environmental Impacts of Continued Storage of Spent Nuclear Fuel Beyond the Licensed Life for Operations of a Reactor" (79 FR 56238-56264).

E9.23 Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel. NUREG-2157. September 2014. ML14196A105

E9.24 Occupational Radiation Exposure at Commercial Nuclear Power Reactors and Other Facilities 2012 - Forty-Fifth Annual Report, NUREG-0713, Vol. 34. Office of Nuclear Regulatory Research. April 2014. ML14126A597

E9.25 Technical Specifications and Bases for North Anna Independent Spent Fuel Storage Installation (ISFSI), Appendix A to license SNM-2507, Amendment 4, August 4, 2015.

E9.26 North Anna Power Station Unit Numbers 1 and 2 Independent Spent Fuel Storage Installation (ISFSI) Annual Radiological Environmental Operating Report. April 10, 2015. ML15105A241

E9.27 North Anna Power Station Unit Numbers 1 and 2 Independent Spent Fuel Storage Installation (ISFSI) Annual Radioactive Effluent Release Report. April 10, 2015. ML15105A080

E9.28 Safety Evaluation Report, Docket Number 72-16, License Number SNM-2507, Amendment Number 4, August 3, 2015. ML15050A428

E9.29 Generic Environmental Impact Statement for License Renewal of Nuclear Plants, NUREG-1437, Supplement 7, November 2002. ML02338054

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APPENDIX F

ADDITIONAL INFORMATION

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APPENDIX F: ADDITIONAL INFORMATION

F1.0 ADDITIONAL INFORMATION

F1.1 Training and Qualifications (10 CFR 72.28)

Chapter 9 of the North Anna ISFSI Safety Analysis Report (SAR) (Reference F3.1) provides information regarding the qualifications of staff associated with ISFSI operations, personnel training, and the nuclear organization. The ISFSI SAR is updated periodically according to regulatory requirements.

F1.1.1 Technical Qualifications

Dominion Virginia Power has a long history of building and operating safe electric generating stations, including nuclear, fossil, and hydro, along with operating safe electric transmission systems. Since approximately 1968, in preparation for the eventual use of nuclear energy in the generation of electricity, Dominion has followed a policy of educating and training its officers, managers, and employees, both supervisory and non-supervisory, in the nuclear field. Subsidiaries of Dominion Resources, Inc., including Dominion Virginia Power, operate six nuclear power units at three station sites and four ISFSIs; one at the North Anna Power Station, one at the Surry Power Station, one at the Millstone Power Station, and one at the Kewaunee Power Station. Operation and experience with these four ISFSIs have enabled Dominion Virginia Power to acquire the expertise needed for operating the North Anna ISFSI throughout the period of extended operation in a manner that continues to ensure the safety of the public and operating personnel.

F1.1.2 Personnel Training Program

The personnel training program has the objective of providing and maintaining a well-qualified workforce for the safe and efficient operation of the ISFSI. All personnel working in the fuel storage area receive radiation and safety training. Those personnel actually performing dry storage cask and fuel handling functions are given additional training in specific areas as required by the training programs in effect at North Anna Power Station.

All personnel working at the ISFSI receive training structured toward providing and maintaining a well-qualified workforce for the safe and efficient operation of the ISFSI. The existing NAPS training programs are INPO-accredited and are directly applicable to the ISFSI.

Additional training requirements specific to the ISFSI address the following subjects:

- ISFSI Design Basis and Technical Specifications
- ISFSI Layout and Function
- ISFSI Security
- ISFSI Communications Systems
- ISFSI Operation, Emergency, Maintenance, and Administrative Procedures
- SSSC Loading and Unloading, Handling and Onsite Transportation
- SSSC Decontamination Techniques

Following completion of the ISFSI training program requirements, trainees are given a written and practical exam to ensure they understand the important aspects of the information described above. Retention of training records and certifications of proficiency is consistent with that for personnel involved in fuel handling operations.

ISFSI continuing training is consistent with the continuing training requirements in effect at NAPS for personnel involved in fuel handling operations.

Training records are maintained in accordance with Dominion Topical Report DOM-QA-1, "Nuclear Facility Quality Assurance Program Description" (Reference F3.2). Such records include dates and hours of training and other documentation on training subjects, information on physical requirements, job performance statements, copies of written examinations, information pertaining to walk-through examinations, and retesting particulars.

F1.1.3 Operating Organization

The ISFSI is operated under the same corporate management organization responsible for the operation of North Anna Power Station. This organization is depicted in Dominion Topical Report DOM-QA-1, "Nuclear Facility Quality Assurance Program Description" (Reference F3.2).

Due to the passive nature of the ISFSI and its infrequent demands on personnel, ISFSI operations can be scheduled so that the existing station organization can easily accommodate the ISFSI responsibilities without the need for obtaining additional personnel. Dominion will maintain an adequate complement of trained and certified personnel for ISFSI operation throughout the period of extended operation.

F2.0 PRE-APPLICATION INSPECTION

In a meeting with the NRC on September 29, 2015, Dominion presented its plans to perform a pre-application inspection in Fall 2015 (Reference F3.3). The purpose of the inspection was to evaluate the condition of the TN-32 dry storage casks located on reinforced concrete pad No. 1.

The pre-application inspection was performed by NDE staff qualified to perform visual inspections and focused on those inaccessible areas and subcomponents, which are not visible during the quarterly visual inspection. The specific subcomponents inspected included the bottom of dry storage cask TN-32.49 and the subcomponents located beneath the protective cover of dry storage cask TN-32.23, including the interior surfaces of the protective cover and associated seal and bolting, the cask flange, the cask lid and lid bolts, the top neutron shield enclosure and neutron shield bolts, and the overpressure system components. The exterior surfaces of the protective cover and upper and lower trunnions were also inspected, as well as the protective cover subassembly. For the TN-32 dry storage casks at the North Anna ISFSI, loss of material from the metal surfaces due to various corrosion mechanisms is the aging effect of concern.

F2.1 Basis for Pre-application Inspection Cask Selection

A number of factors are to be considered when selecting cask(s) for pre-application inspection, including heat generation, atmospheric contaminants, material combinations, etc.

Additional factors considered for North Anna included the August 2011 seismic event and leakage through the protective cover due to improper assembly of the Conax connector first identified at Surry in 2000 (Refer to Element 10: Operating Experience). Table F2-1, Factors Affecting Cask Selection (Cask Bottom Inspection) and Table F2-2, Factors Affecting Cask Selection (Cask Top Inspection) provide a summary of the cask data considered when selecting a cask for bottom pre-application inspection and top pre-application inspection.

F2.1.1 Cask Bottom Inspection Selection Criteria

The August 23, 2011, seismic event and aftershock resulted in movement of 25 of 27 TN-32 casks on reinforced concrete pad No. 1. Lateral movement of individual casks ranged from 0.5 to 4.5 inches.

The factors affecting selection of the cask for the bottom inspection include the following:

1. Accessibility with the transporter - The transporter can only access casks from the North or South end of reinforced concrete pad No. 1. Only four casks (TN-32.45, TN-32.49, TN-32.52, and TN-32.53) are accessible, unless other casks are relocated first. Figure F2-1, Locations of Casks Considered for Pre-application Inspections identifies the location of the four casks. A license amendment request has been submitted to place a high burnup demonstration cask on reinforced concrete pad No. 1. Placement of the high burnup cask will block access to cask TN-32.45. Only three casks, therefore, remain accessible to the transporter.

2. Movement during seismic events - Of the three accessible casks, TN-32.49 experienced the greatest movement.

3. Decay heat of fuel in the cask - Of the three accessible casks, the fuel in TN-32.49 had the second highest decay heat when the cask was initially loaded, but this value is only 6% less than TN-32.52.

4. Time since loading - Casks TN-32.49 and TN-32.52 have comparable load dates.

Based on the above, dry storage cask TN-32.49 was chosen for the bottom inspection.

Figure F2-1 Locations of Casks Considered for Pre-application Inspections

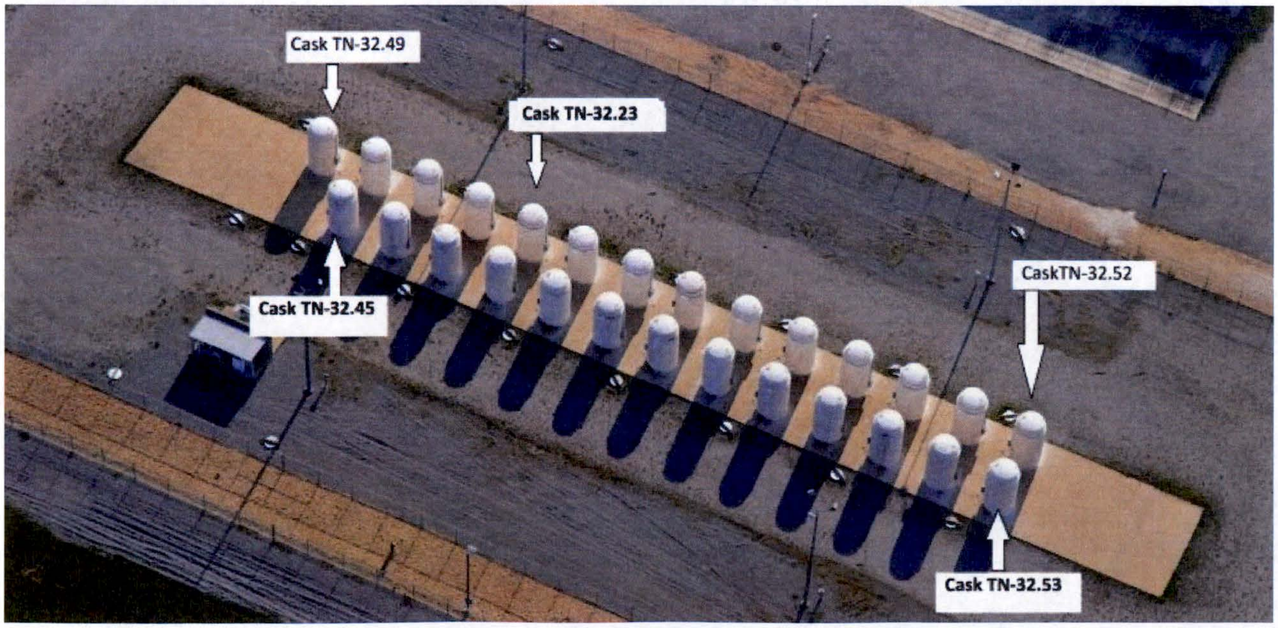


Table F2-1 Factors Affecting Cask Selection (Cask Bottom Inspection)

Cask	Accessible with Transporter	Seismic Event Movement (In)	Decay Heat When Loaded (KW)	Date Loaded
TN-32.06	No	1.5	16.9	7/31/98
TN-32.10	No	2.5	18.28	8/24/98
TN-32.12	No	0.5	15.40	6/08/99
TN-32.13	No	1.0	14.13	7/19/99
TN-32.14	No	0.75	13.30	12/14/98
TN-32.16	No	3.5	15.39	6/19/00
TN-32.19	No	2.25	16.20	8/22/00
TN-32.20	No	1.0	14.94	9/18/00
TN-32.21	No	4.5	21.29	1/16/01
TN-32.23	No	3.5	17.96	7/30/01
TN-32.24	No	3.0	22.15	8/13/01
TN-32.26	No	1.25	15.95	1/28/02
TN-32.29	No	2.0	13.62	2/18/02
TN-32.30	No	0.0	13.92	8/20/02
TN-32.32	No	1.5	13.84	11/05/02
TN-32.36	No	4.0	28.53	7/21/03
TN-32.37	No	3.0	28.29	8/18/03
TN-32.38	No	1.0	28.72	9/08/03
TN-32.41	No	0.0	25.62	12/08/03
TN-32.42	No	1.5	25.95	2/02/04
TN-32.43	No	3.5	26.01	3/08/04
TN-32.45*	Yes	1.5	26.21	6/21/04
TN-32.47	No	1.0	26.43	4/04/05
TN-32.48	No	2.0	30.10	6/05/06
TN-32.49	Yes	3.0	28.94	8/21/06
TN-32.52*	Yes	2.0	30.66	9/18/06
TN-32.53*	Yes	2.5	20.70	1/25/07

* = other accessible casks

F2.1.2 Cask Top Inspection Selection Criteria

In 2000, plant personnel at Surry Power Station identified that the design of the Conax electrical connectors, which penetrate the top of the protective cover of the TN-32 dry storage casks, allowed water to enter inside the cover and ultimately corrode the cask outer lid seal resulting in a cask low pressure alarm. As a result, the protective covers were modified to eliminate the Conax connector. Beginning in July 2001, all new TN-32 dry storage casks loaded at North Anna were provided with the new protective cover design, beginning with dry storage cask TN-32.23 (refer to Table F2-2, Factors Affecting Cask Selection (Cask Top Inspection). The nine remaining casks loaded between 1998 and January 2001 had their protective covers replaced between March 2002 and June 2003, which is after the date dry storage cask TN-32.23 was placed on the pad. In summary, the protective cover on dry storage cask TN-32.23 has been in place the longest.

The factors affecting selection of the TN-32 dry storage cask for inspections under the protective cover (top inspection) include the following (Refer to Table F2-2):

1. Time since cover installation - The nine casks that have been on reinforced concrete pad No. 1 the longest period of time have had their protective covers replaced. TN-32.23 is the oldest dry storage cask on reinforced concrete pad No. 1 that has not had its cover replaced.
2. Movement during seismic events - Dry storage cask TN-32.23 experienced movement of 3.5 inches from the August 2011 seismic event and aftershock.
3. Previous post-seismic inspections - Dry storage cask TN-32.23 was not inspected following the August 2011 seismic event.
4. Dry storage cask TN-32.23 was not included in the 2014 re-coating efforts.

Based on the above, dry storage cask TN-32.23 was chosen for the top inspection.

Table F2-2 Factors Affecting Cask Selection (Cask Top Inspection)

Cask	Date Protective Cover Replaced	Seismic Event Movement (In)	Date Loaded	Inspected Following Seismic Event	Re-coated in 2014
TN-32.06	3/07/02	1.5	7/31/98	No	Yes
TN-32.10	3/15/02	2.5	8/24/98	No	No
TN-32.12	6/06/02	0.5	6/08/99	No	Yes
TN-32.13	5/10/02	1.0	7/19/99	No	No
TN-32.14	6/6/03	0.75	12/14/98	No	Yes
TN-32.16	6/10/03	3.5	6/19/00	No	No
TN-32.19	6/12/03	2.25	8/22/00	No	No
TN-32.20	6/20/03	1.0	9/18/00	No	No
TN-32.21	6/24/03	4.5	1/16/01	Yes	Yes
TN-32.23	N/A	3.5	7/30/01	No	No
TN-32.24	N/A	3.0	8/13/01	Yes	Yes
TN-32.26	N/A	1.25	1/28/02	No	No
TN-32.29	N/A	2.0	2/18/02	No	No
TN-32.30	N/A	0.0	8/20/02	Yes	No
TN-32.32	N/A	1.5	11/05/02	No	Yes
TN-32.36	N/A	4.0	7/21/03	Yes	No
TN-32.37	N/A	3.0	8/18/03	No	No
TN-32.38	N/A	1.0	9/08/03	No	No
TN-32.41	N/A	0.0	12/08/03	Yes	No
TN-32.42	N/A	1.5	2/02/04	No	Yes
TN-32.43	N/A	3.5	3/08/04	No	No
TN-32.45	N/A	1.5	6/21/04	No	No
TN-32.47	N/A	1.0	4/04/05	No	No
TN-32.48	N/A	2.0	6/05/06	No	Yes
TN-32.49	N/A	3.0	8/21/06	No	No
TN-32.52	N/A	2.0	9/18/06	No	No
TN-32.53	N/A	2.5	1/25/07	No	Yes

F2.2 Pre-application Inspection Results

NDE visual inspection was performed on the bottom of dry storage cask TN-32.49 and beneath the protective cover of dry storage cask TN-32.23. Condition reports were entered in the Dominion Corrective Action Program to document the inspections.

Approximately 100 photographs were taken during the inspection. Table F2-3, Representative Photos from Pre-application Inspections provides a list and description of pictures that were chosen as representative of those taken during the pre-application inspection. These pictures are included as Figure F2-6 through Figure F2-17. Figure F2-2, Figure F2-3, Figure F2-4 and Figure F2-5 provide the templates used to record the location of pictures taken during the inspection. Figure F2-2 is the TN-32.49 cask bottom template, Figure F2-3 and Figure F2-4 are the templates for the TN-32.23 protective cover inner and outer surfaces, and Figure F2-5 is the TN-32.23 cask top template with the protective cover removed. Picture labels appearing in bold print on Figure F2-2 through Figure F2-5 identify the location of pictures appearing in Figure F2-6 through Figure F2-17. Figure F2-18 is a picture of the NDE character resolution card used during the inspection.

The results of the bottom inspection revealed areas where portions of the protective coating exhibited loss of adhesion and areas where the coating adhered to the concrete. Approximately 35% of the bottom surface either had a loss of coating or the coating was deficient. Rust stains were also observed. There was no detectable loss of material from the base metal and therefore no corrective actions were necessary. Figure F2-19 provides a representative picture of reinforced concrete pad No. 1 taken during the inspection.

Visual inspection of the concrete beneath the cask was performed by Civil Engineering using the guidance in ACI 349.3R and revealed no detectable degradation, other than shrinkage cracking that occurred during concrete curing. Civil Engineering determined the shrinkage cracking would not result in future degradation of reinforced concrete pad No. 1 and no corrective actions were necessary.

The protective cover was removed on dry storage cask TN-32.23 to perform NDE visual examination of the cover and the components beneath the cover. The upper and lower trunnions were also inspected, as well as four of the protective cover bolts and two of the neutron shield bolts.

The inside and outside of the protective cover and subassembly were found to be acceptable and no blemishes or rust stains were noted. The protective cover Viton seal was in acceptable condition and did not require replacement. Surface corrosion stains were noted on four of the protective cover bolt holes, but no detectable loss of material.

The upper and lower trunnions exhibited surface corrosion on the top of each trunnion. The bottom half of each trunnion appeared to have a narrow ring of surface corrosion as well. There was no detectable loss of material from the trunnions.

The visible portions of the lid, lid bolts, top neutron shield enclosure, neutron shield bolts, and overpressure system components were all in acceptable condition, i.e., no detectable loss of material from the base metal.

Four of the twelve protective cover bolts and two of the four neutron shield bolts were inspected using VT-1 NDE techniques. Two protective cover bolts were noted to have surface corrosion stains on the bolt shank, but no detectable loss of material. The stains were easily removed with Scotch-Brite. No corrosion or rust stains were noted on the neutron shield bolts (see Figure F2-17). No galling of the threads was noted on any of the bolts inspected.

The intended functions of the sub components in the scope of license renewal were not challenged by the observed corrosion/rust deposits. Based on the results of the above inspections, the TN-32 dry storage casks are capable of performing their intended functions throughout the period of extended operation.

F2.3 Pre-application Inspection Photos

Table F2-3 Representative Photos from Pre-application Inspections

Photo Identifier	Photo Description	Location Figure	Examination Technique
GP-2	Cask TN-32.49 bottom	Figure F2-2	VT-3
GP-8	Cask TN-32.49 bottom	Figure F2-2	VT-3
GP-10	Cask TN-32.49 bottom	Figure F2-2	VT-3
GP-19	Cask TN-32.49 bottom	Figure F2-2	VT-3
GP-28	Cask TN-32.49 bottom	Figure F2-2	VT-3
GP-32	Cask TN-32.49 bottom	Figure F2-2	VT-3
GP-36	Cask TN-32.49 bottom	Figure F2-2	VT-3
GP-38	Cask TN-32.49 bottom	Figure F2-2	VT-3
SLR-8	Cask TN-32.49 bottom and concrete, general	Figure F2-2	N/A
SLR-18	Cask TN-32.23 protective cover outer surface	Figure F2-3	VT-3
SLR-20	Cask TN-32.23 protective cover outer surface	Figure F2-3	VT-3
SLR-30	Cask TN-32.23 protective cover bolt hole	Figure F2-3	VT-3
SLR-32	Cask TN-32.23 protective cover bolt hole	Figure F2-3	VT-3
SLR-37	Cask TN-32.23 protective cover subassembly flange	Figure F2-3	VT-3
SLR-34	Cask TN-32.23 protective cover inside surface	Figure F2-4	VT-3
SLR-36	Cask TN-32.23 protective cover seal and seal flange	Figure F2-4	VT-1 (flange only)
SLR-25	Cask TN-32.23 east upper trunnion	Figure F2-5	VT-3
SLR-39	Cask TN-32.23 top, protective cover removed	Figure F2-5	VT-3 (VT-1 for cask flange surface)
SLR-40	Cask TN-32.23 top, protective cover removed	Figure F2-5	VT-3 (VT-1 for cask flange surface)
SLR-41	Cask TN-32.23 east neutron shield bolt hole	Figure F2-5	VT-3
SLR-43	Two neutron shield bolts prior to and after cleaning	None	VT-1
NDE-1	Character Resolution Card Photograph	None	N/A
None	Reinforced Concrete Pad No. 1 Surface Crazing	None	N/A

Figure F2-2 Cask TN-32.49 Bottom Inspection Photo Locations

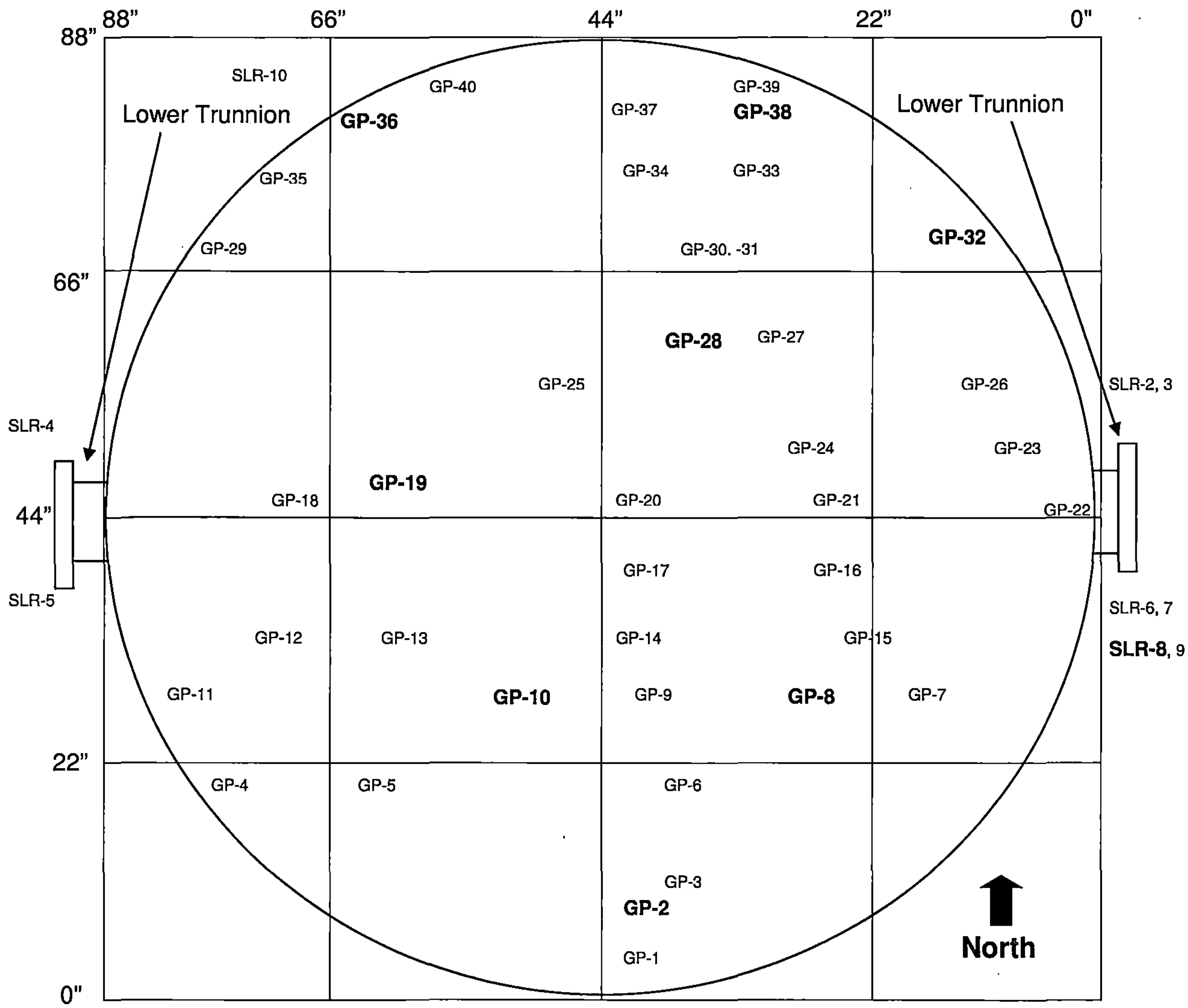


Figure F2-3 Cask TN-32.23 Protective Cover Inspection (Outside)

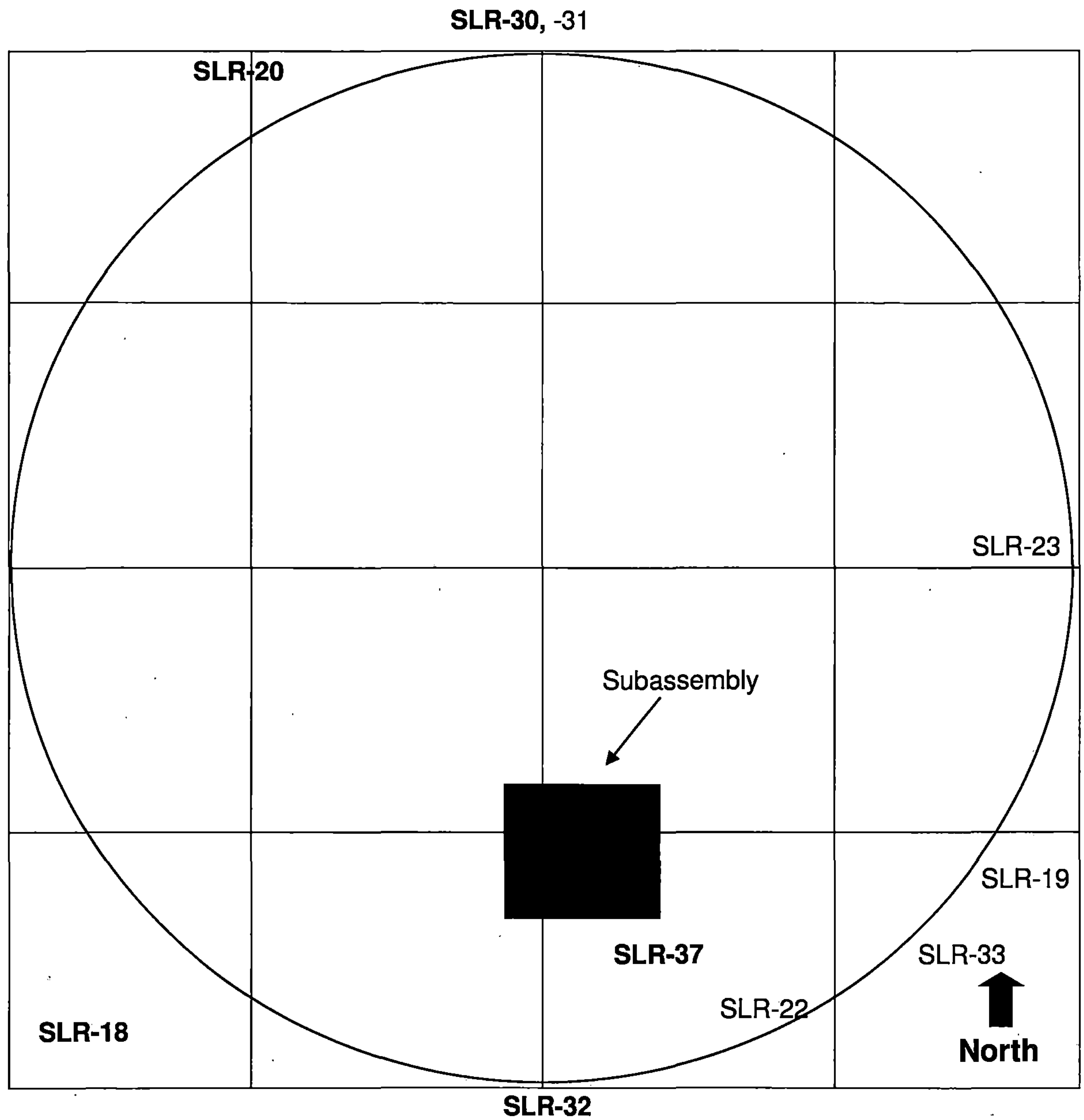


Figure F2-4 Cask TN-32.23 Protective Cover Inspection (Inside)

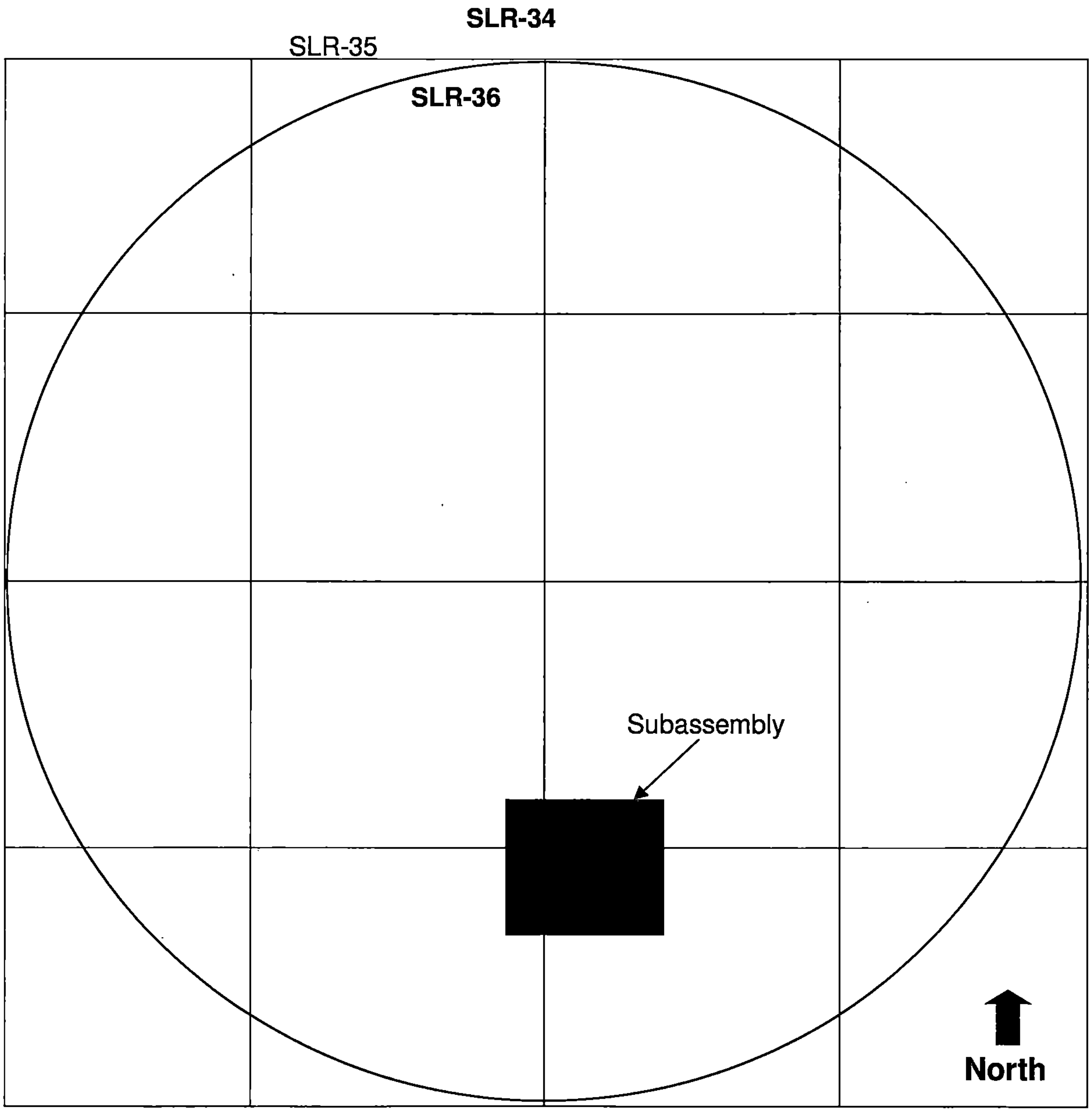


Figure F2-5 Cask TN-32.23 Top Inspection Photo Locations

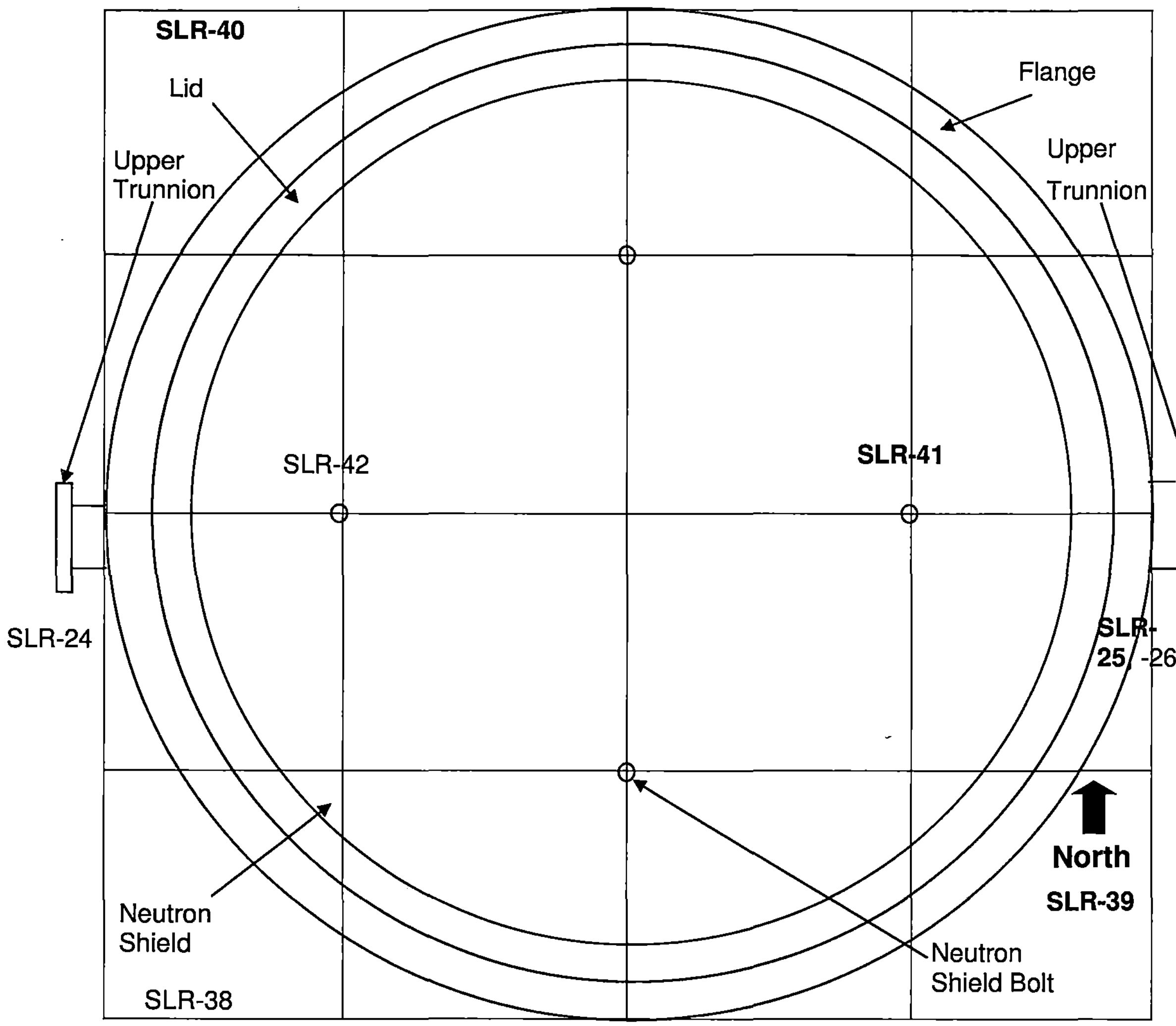


Figure F2-6   Cask TN-32.49 Bottom Inspection Photos GP-2 and GP-8

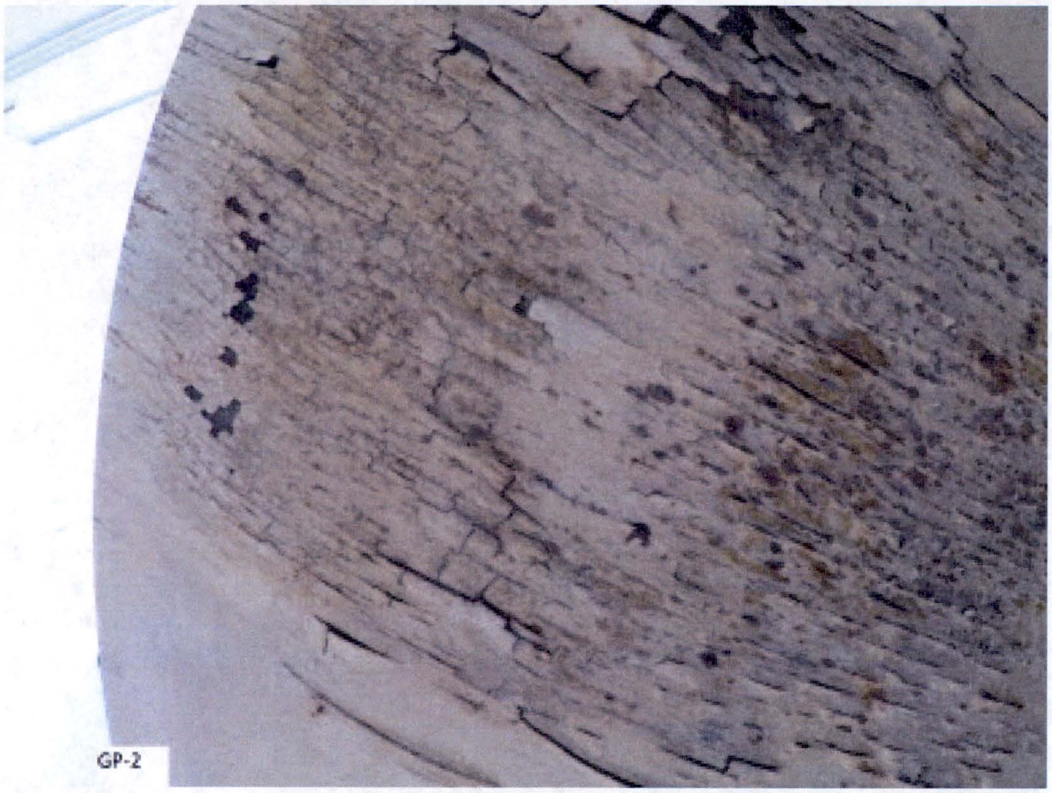
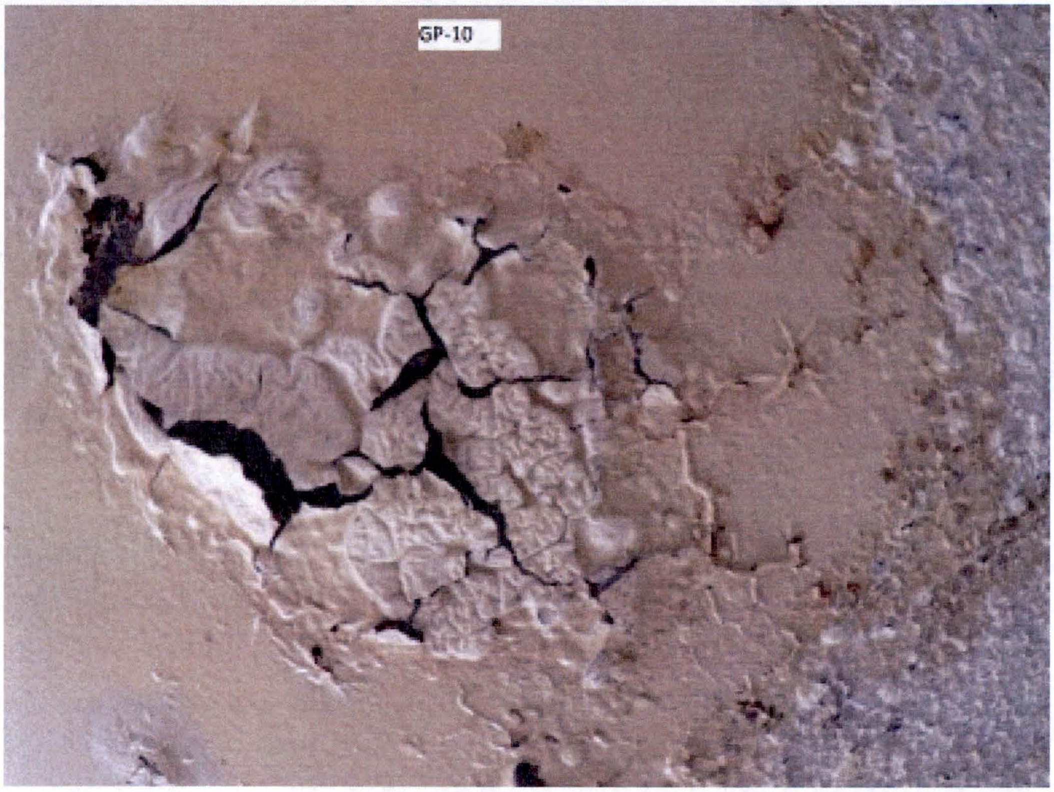


Figure F2-7 Cask TN-32.49 Bottom Inspections Photos GP-10 and GP-19



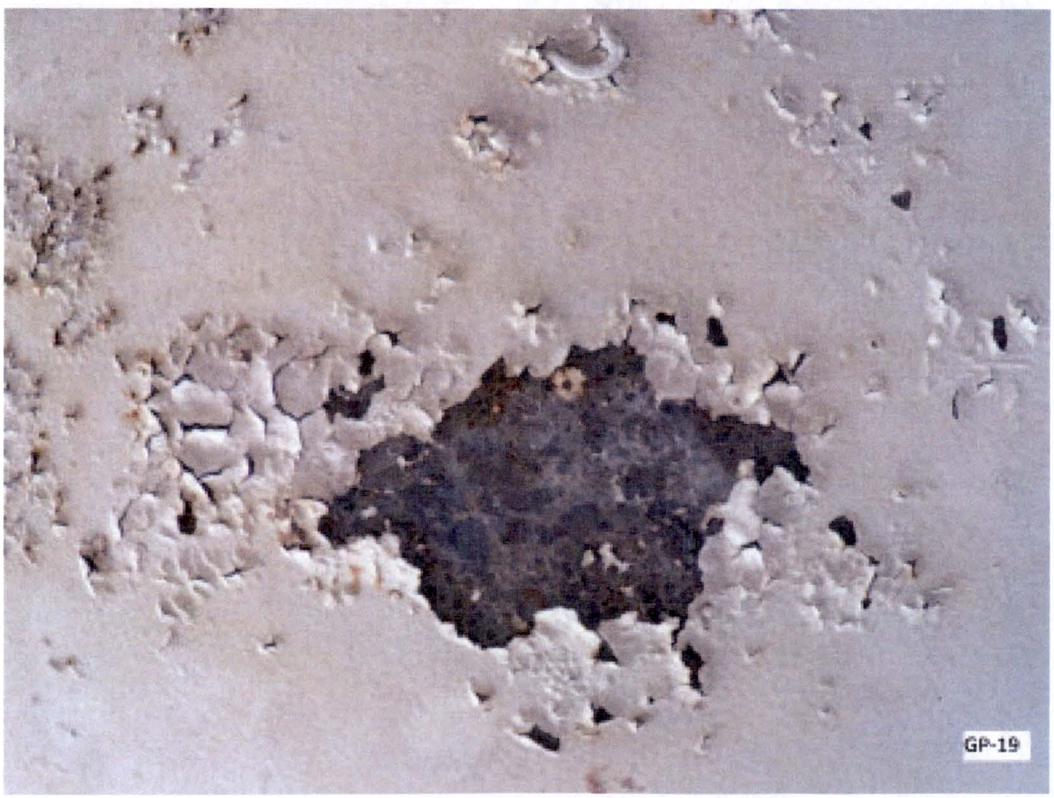
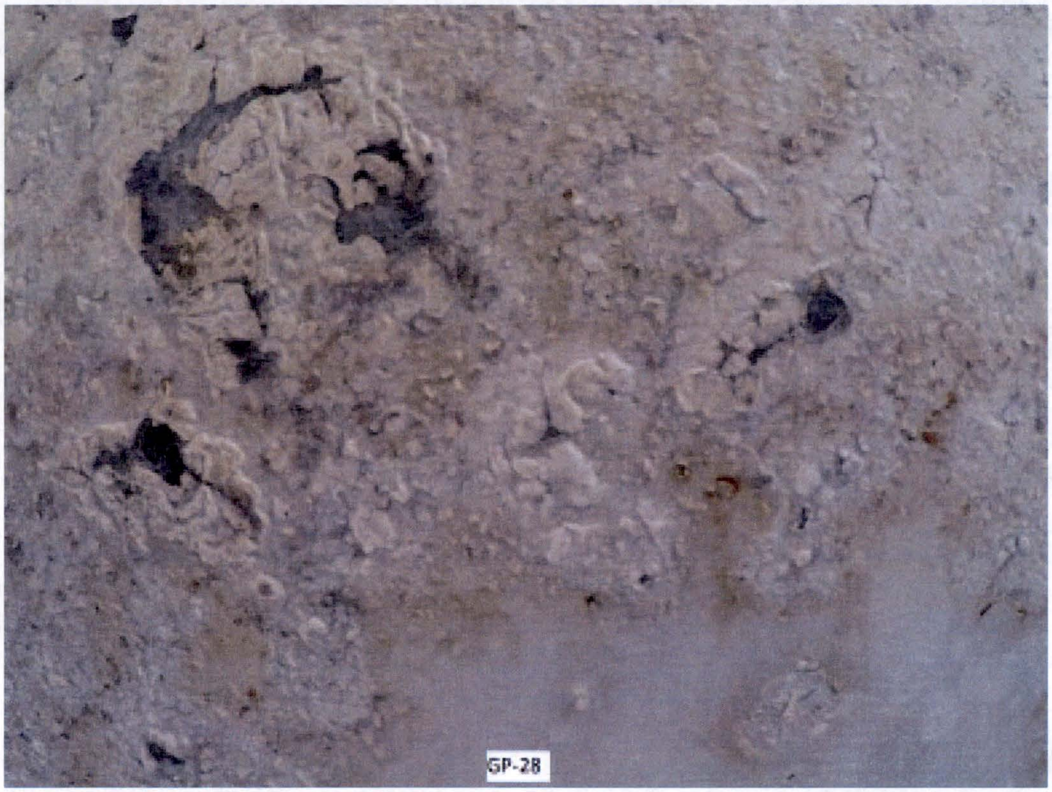


Figure F2-8 Cask TN-32.49 Bottom Inspection Photos GP-28 and GP-32



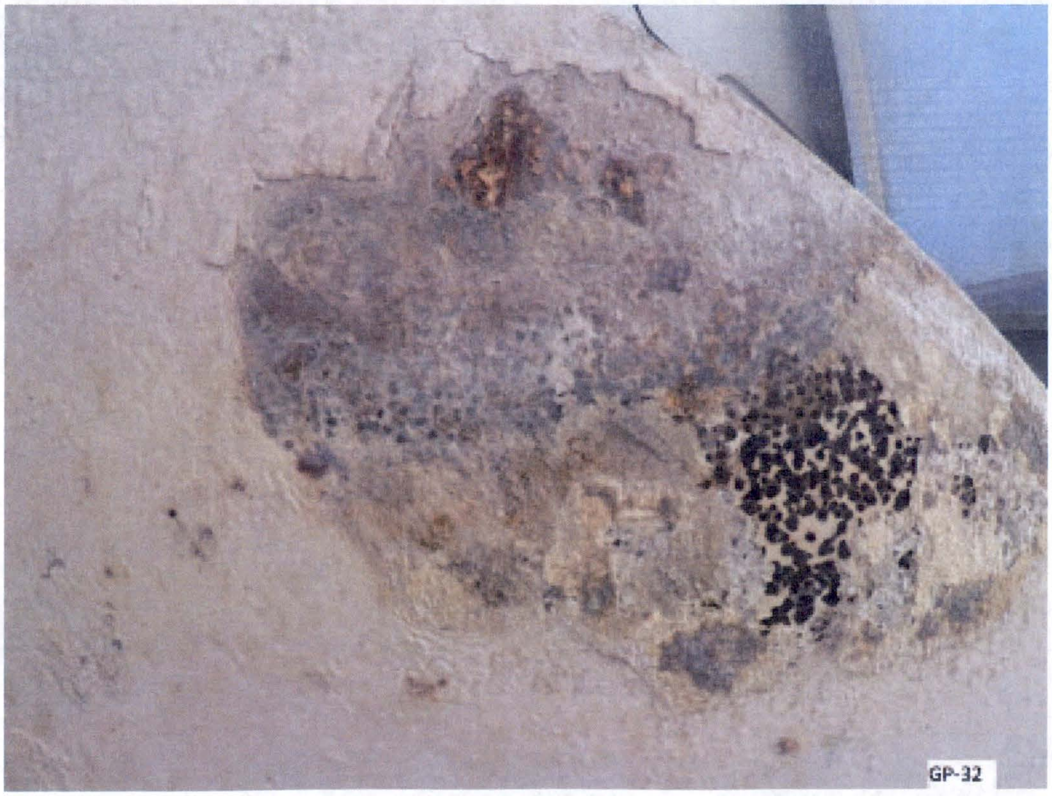


Figure F2-9 Cask TN-32.49 Bottom Inspection Photos GP-36 and GP-38

Figure F2-10 Cask TN-32.49 Bottom and Concrete Photo SLR-8

Figure F2-11 Cask TN-32.23 Protective Cover Photos SLR-18 and SLR-20

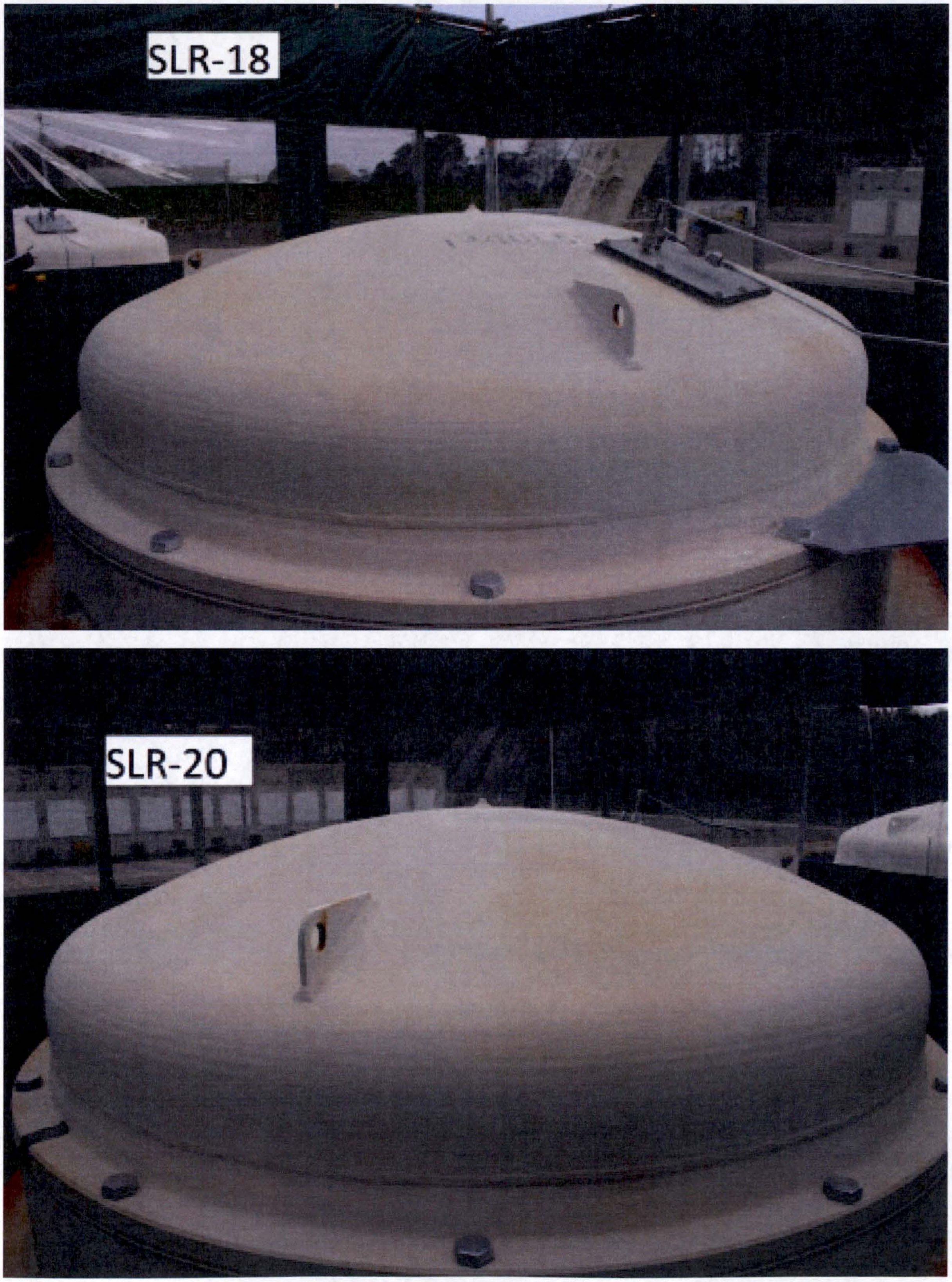
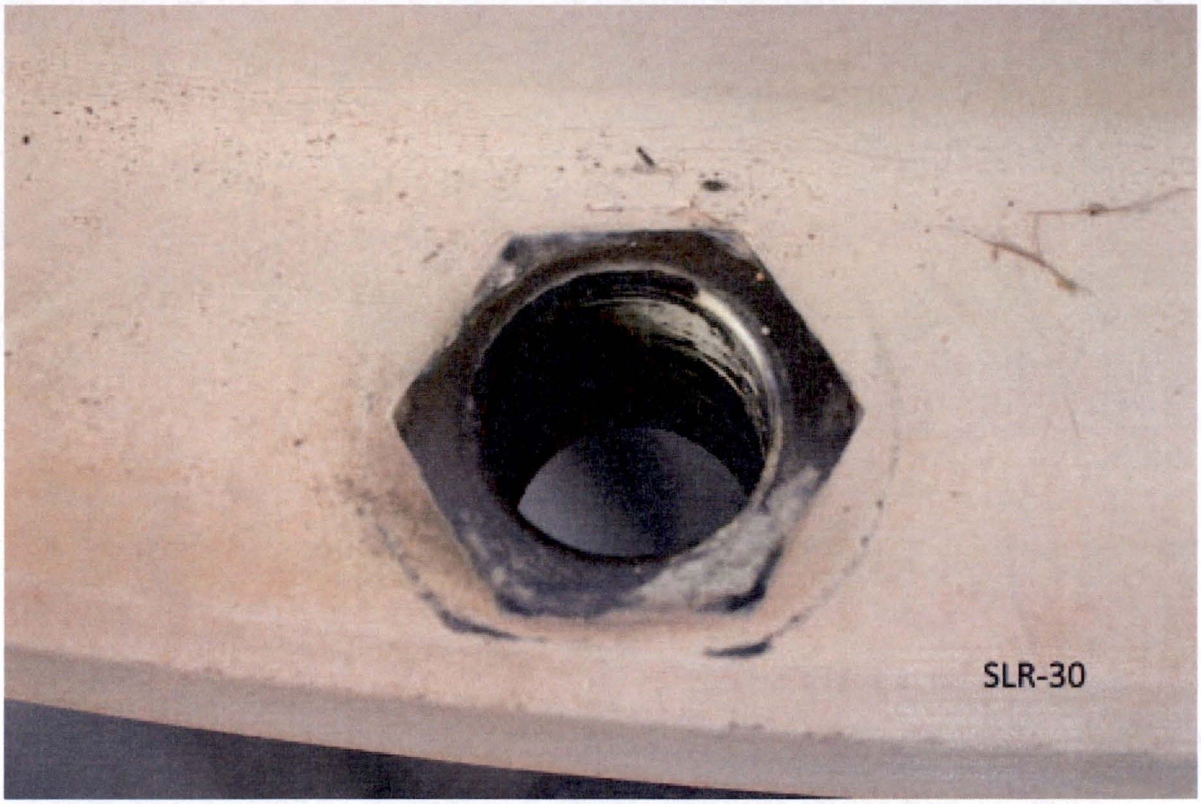


Figure F2-12 Cask TN-32.23 Protective Cover Photos SLR-30 and SLR-32



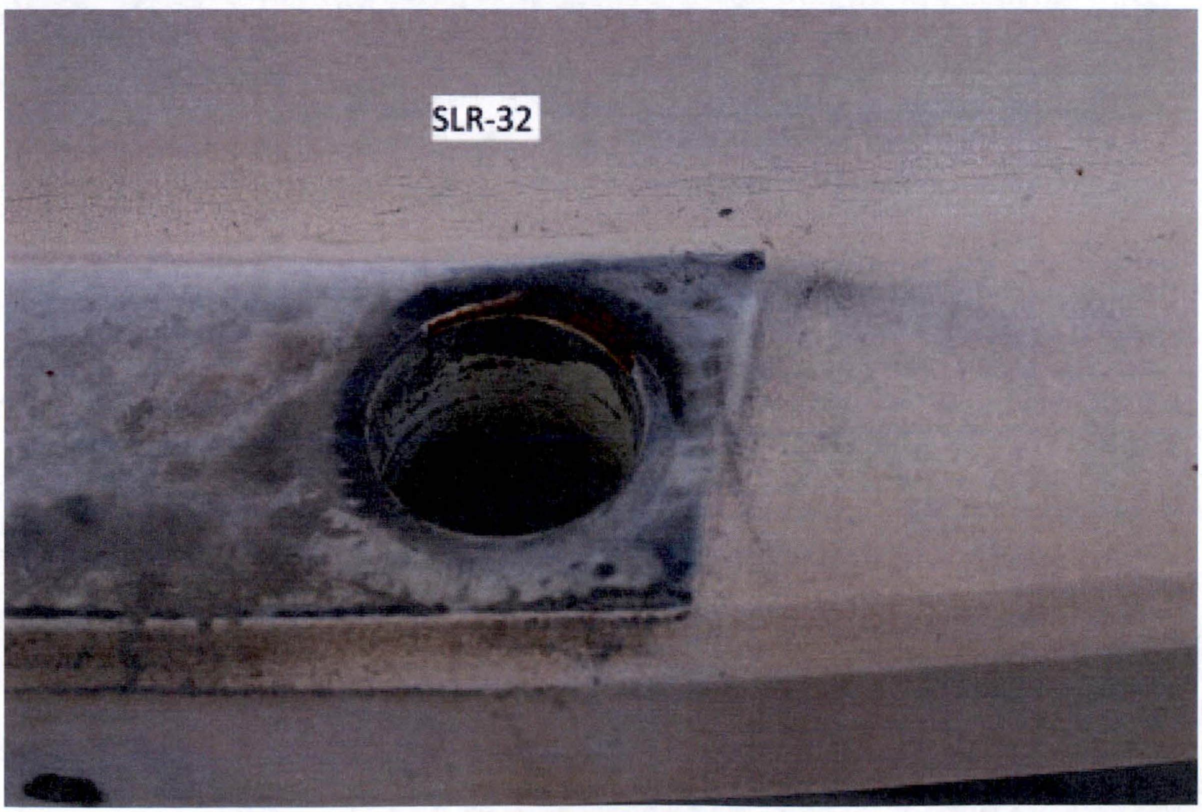
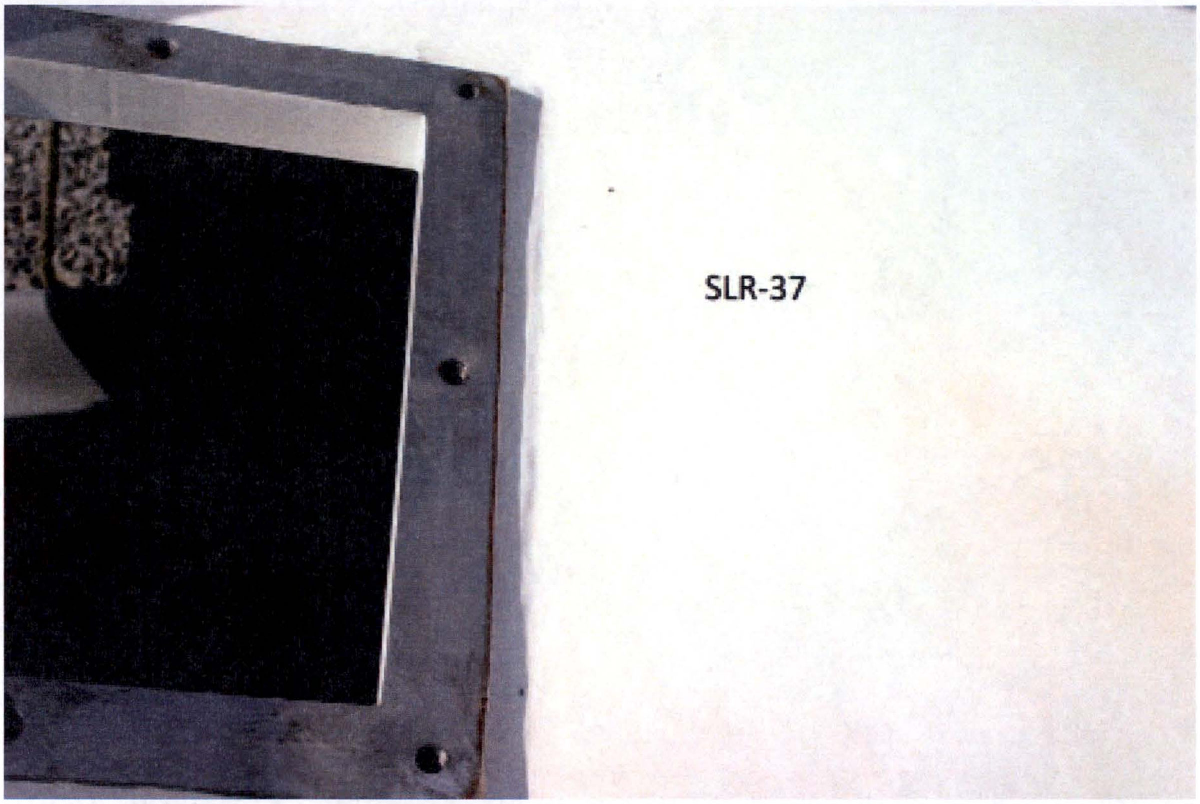


Figure F2-13 Cask TN-32.23 Protective Cover Photos SLR-37 and SLR-34



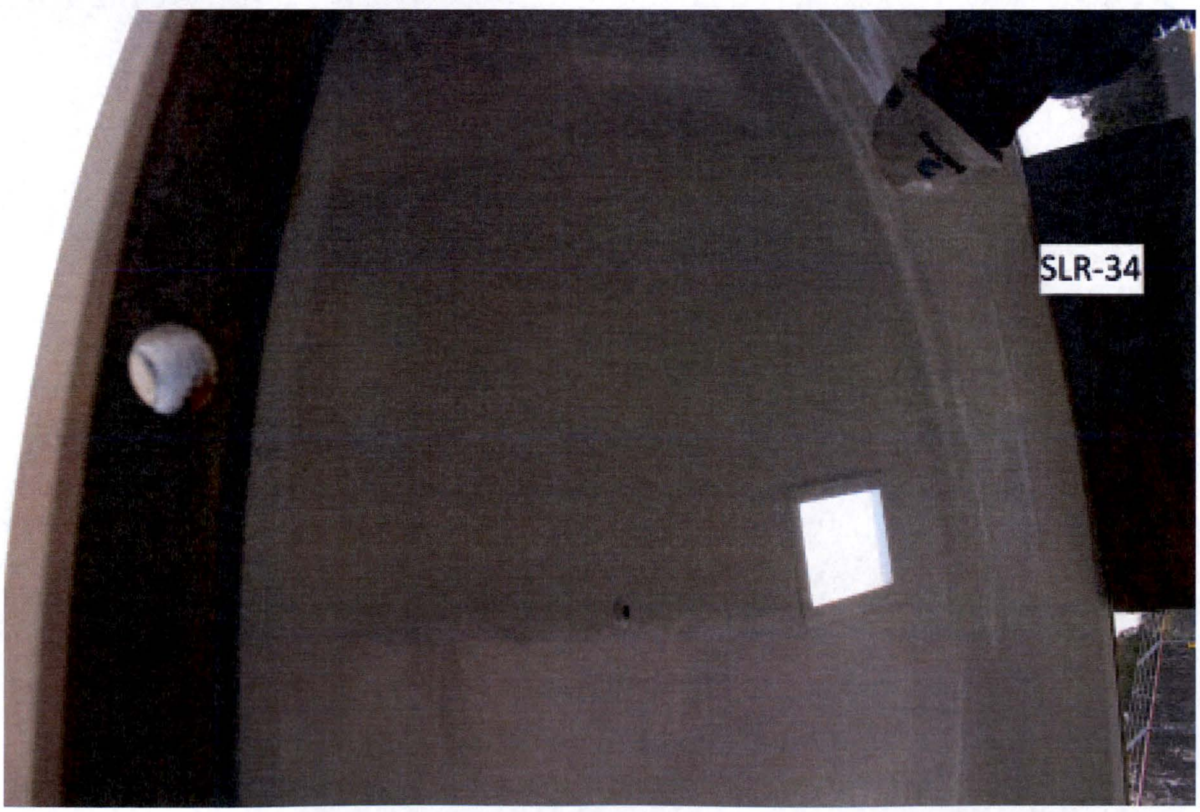


Figure F2-14 Cask TN-32.23 Protective Cover Photos SLR-36 and SLR-25

Figure F2-15 Cask TN-32.23 Inspection Photos SLR-39 and SLR-40

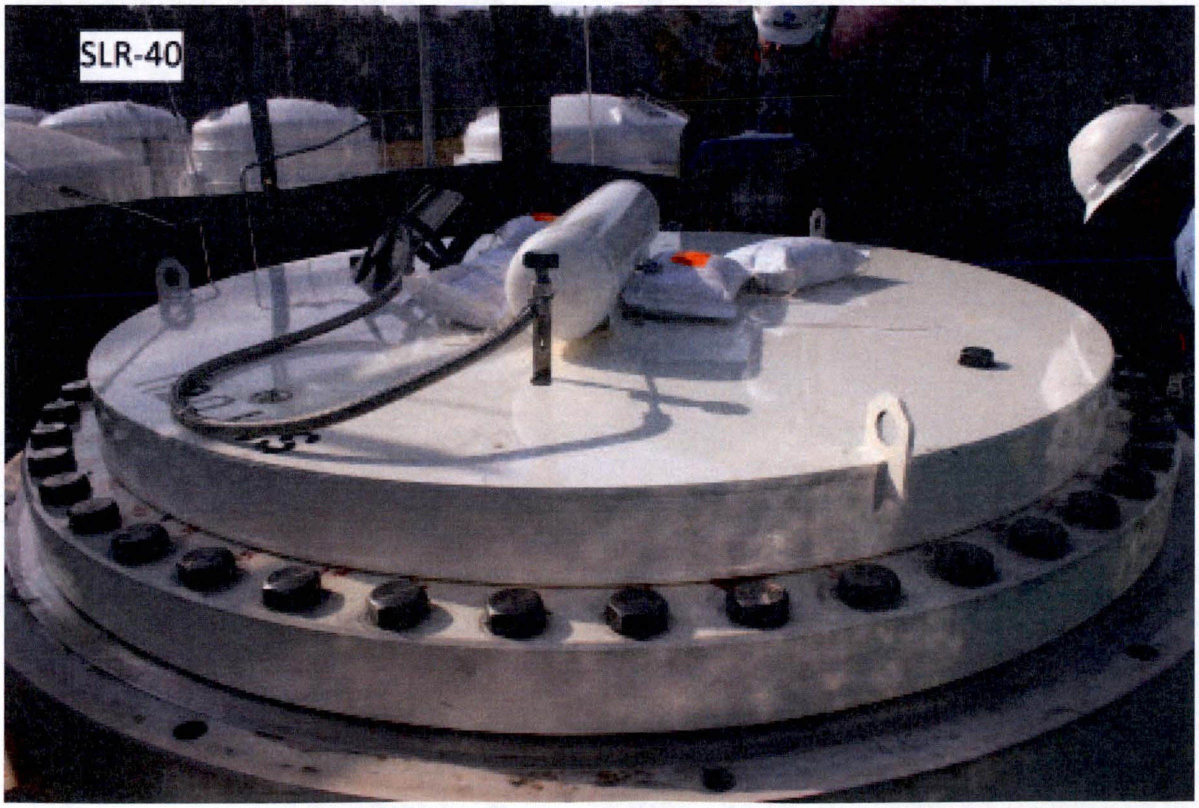


Figure F2-16 Cask TN-32.23 Protective Cover Photo SLR-41

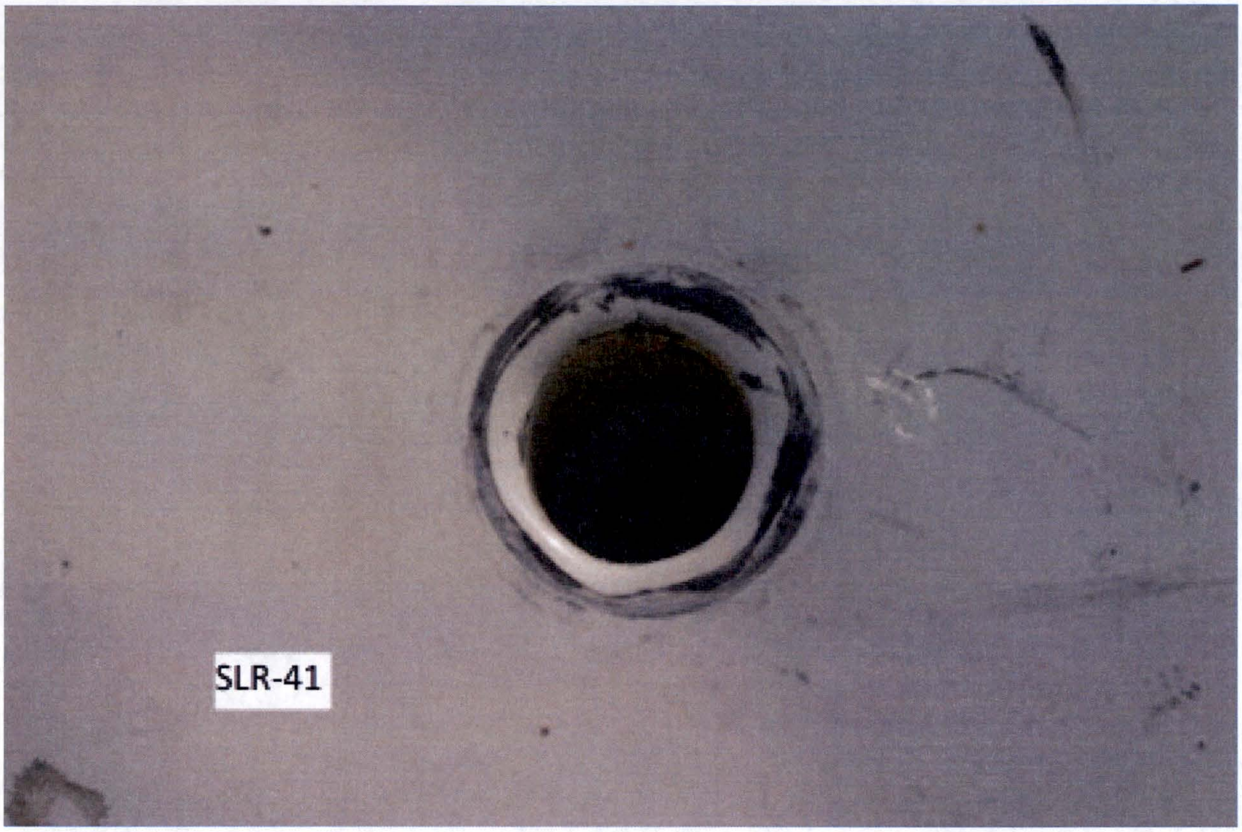


Figure F2-17 Cask TN-32.23 Neutron Shield Bolts Photo SLR-43

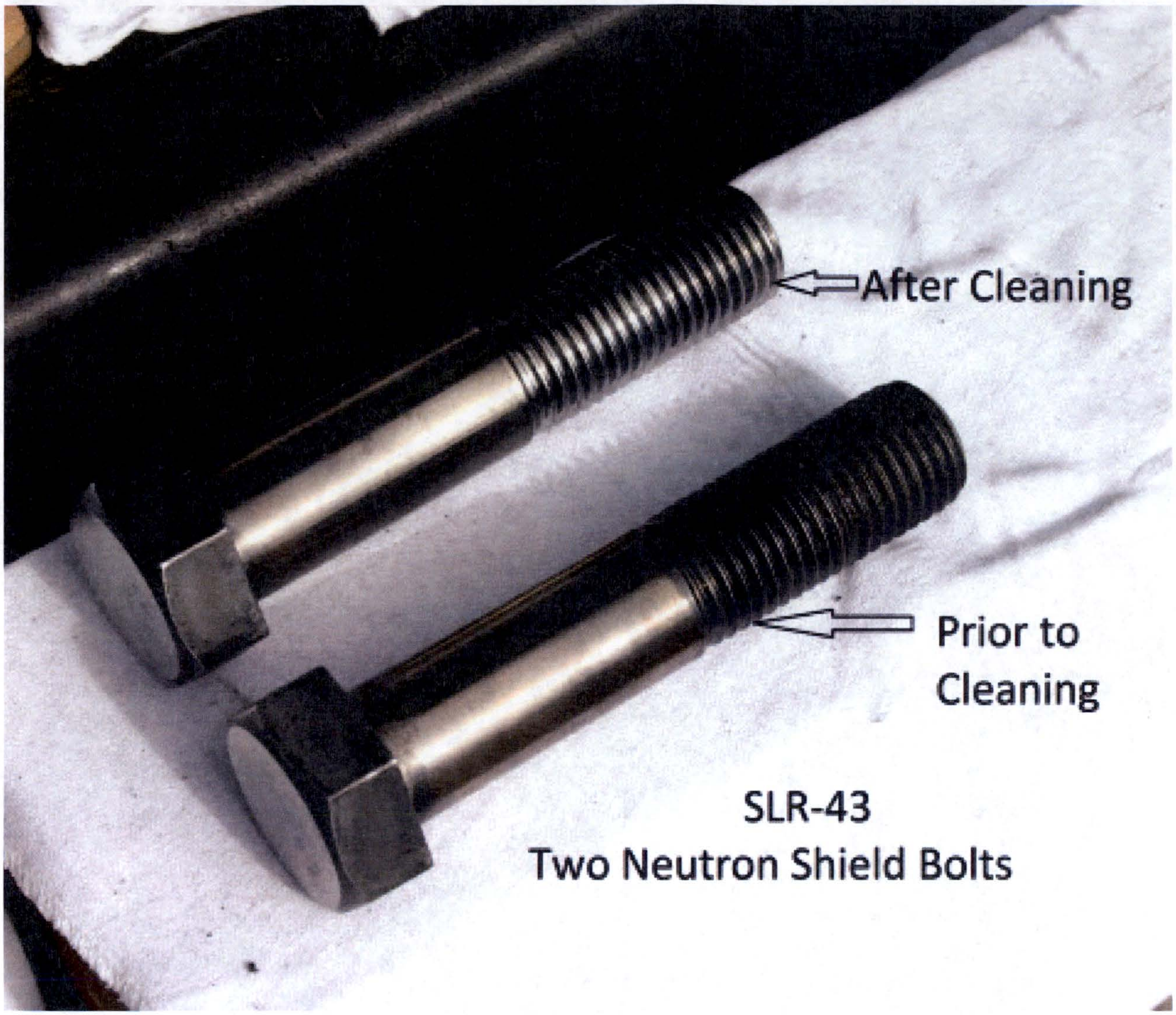


Figure F2-18 NDE Character Resolution Card NDE-1

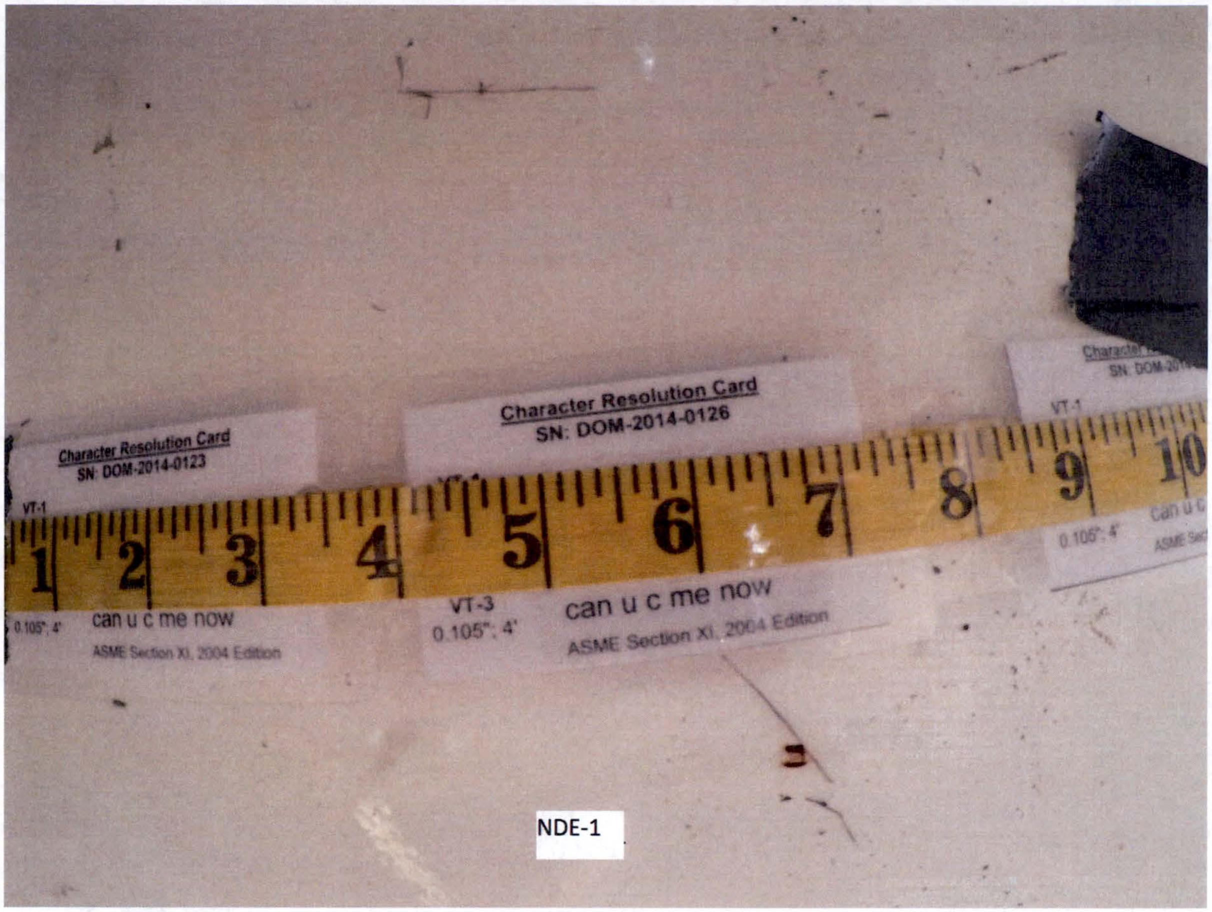


Figure F2-19 Reinforced Concrete Pad No. 1 Surface Crazing

F3.0 REFERENCES (APPENDIX F: ADDITIONAL INFORMATION)

F3.1 North Anna Independent Spent Fuel Storage Installation Safety Analysis Report, Rev. 8, North Anna Power Station. ML14233A488

F3.2 DOM-QA-1, Nuclear Facility Quality Assurance Program Description, Topical Report, Dominion.

F3.3 Dominion Presentation to NRC, "North Anna ISFSI License Renewal," September 29, 2015. ML15261A690

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APPENDIX G

NON-QUANTIFIABLE TERMS

Contents

Appendix G: Non-Quantifiable Terms - **G-1**

TABLES

Table G-1 Screening Criteria for Non-Quantifiable Terms - G-1

Table G-2 Non-Quantifiable Terms - G-2

APPENDIX G: NON-QUANTIFIABLE TERMS

Per NUREG-1927, non-quantifiable terms may appear in the ISFSI license renewal application. Table G-1 may be used as guidance for additional consideration, or to provide quantitative measures or information.

Table G-1 Screening Criteria for Non-Quantifiable Terms

Result	Criterion	Actions
Screens In	The term requires additional consideration if it is used for one of the following: • characterizing an aging effect (e.g., degradation, cracking, fatigue, corrosion, loss of material, change in material properties) • providing important information about the operations, functions, or other characteristics of an in-scope SSC • describing dose, environmental impact, or other hazard, such as combustible material or dust	If the term screens in, one of the following must be provided: • quantitative information, if it is available • additional descriptions • definition of the meaning of the term (e.g., "insignificant" means the function of the SSC is not impaired)

Screens Out	The term is considered not material to the ISFSI/DSS SAR for one of the following reasons:
	• The term is included in the title of reference document.
	• The term is included in a quote.
	• The term is explained by adjacent quantitative information (e.g., small: less than 20 percent).
	• Use of the term is NOT related to any of the following:
	  • in-scope SSCs per AMR results
	  • aging effect
	  • dose, environment impact, or other hazard (e.g., combustible material)
	• Use of the term does not provide important information. It is merely descriptive and the meaning of the statement is not changed if the term is deleted (e.g., the word "small" could be deleted from the following statement without altering the meaning: "Water in the grapple ring is drained through a small hole").
		No Action required

Table G-2 Non-Quantifiable Terms

Term	Location
large, larger, largest (descriptive use)	Appendix E: Section E3.1 (largest community within 10 miles); Section E7.0 (largest direct benefit, larger adverse environmental impacts)
small (descriptive or environmental definition)	Table 3.1-1 Footnote 2 (Small gaps may exist where metal to metal...); SMALL environmental/dose impact/small fraction - per regulatory definitions): Appendix E Sections E3.11.1, E4.0, E4.2.3, E4.3, E7.0
slight, slightly	Appendix E: Section E3.3 (...slightly diminished maneuverability)
significance, significant, significantly (descriptive, QA/CR, or environmental/ cultural definitions)	Table 2.3-2, Scoping Results (SAR quote: no other significant combustible sources); Appendix A Cask AMP Element 5: (Depending on significance...), Cask AMP Element 7: (significantly adverse to quality, significance level, significant events); Pad AMP Element 7: (significantly adverse to quality, significance level, significant events); Pad AMP Element 10: (significantly adverse); Appendix C Section C2.1.1.2 (significant enough to...); Appendix E: Section E1.3 (significant change); Section E1.4.2 (historically significant sites); Section E3.9 (historically significant sites); Section E3.11.1 (new and significant sensitivity analysis)
moderate, moderately	None
low (descriptive, generic terminology)	Low-alloy steel: Section 2.4.1, Section 3.2.1, Table AMR Results-1, Cask AMP Element 1:, Element 4:, Table C2.1-1; Low pressure alarm: Section 2.5.1.13, Element 4:, Element 5:, Element 6:, Element 10:, Table A2.1-3, Section C2.1.1.1, Section F2.1.2; Low corrective action threshold: Cask AMP Element 6:; Low-burnup fuel: Section 3.3.2, Section 3.3.3, Section E4.2; Low-level radioactive waste: Section E1.2.2; Low-level seismicity: Section E3.4 Low-income: Section E3.11.2, Section E4.3; ALARA: Section E4.2.1, Section E5.0
minor	Table AMR Results-2 Footnote 1 (potential for minor fuel cladding defects exists) Appendix A: Cask AMP Element 10: (minor coating degradation - explained)
few, little, many, routine	None
some (descriptive)	Appendix E Section E2.2.3 (some of the impacts); Section E3.3 (some increases in traffic); Section E8.1(some impact is unavoidable)
major (descriptive)	Section 2.4.1 (major subcomponents), Section 3.1 (three major steps) Appendix C: Section C2.1 (ISFSI major components), Appendix E: Section E3.3 (major commuting routes)
undetectable, measurable	None
visible (descriptive)	Appendix A: Cask AMP Element 3: and Element 4: (visible external surfaces, no visible loss, not visible/visible during inspection, visible surfaces), Element 10: (no visible loss), Pad AMP Summary of Enhancements (visible surfaces), Element 10: (visible surfaces), Appendix C: Section C2.1.1.2 (inspection of visible surfaces); Appendix E: Section E3.10 (not visible from off-site roads), Section E4.3, (visible from off site), Appendix F: Section F2.0 (not visible), Section F2.2 (visible portions)
changed, unchanged	Appendix E Section E8.3 (balance... would be unchanged by the renewal)
no loss of	Appendix A Pad AMP Element 4: and Element 10: (no loss of intended function) Appendix C Section C2.1.1.1 (no loss of material)

APPENDIX H

ISFSI DECOMMISSIONING FUNDING PLAN

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APPENDIX H: ISFSI DECOMMISSIONING FUNDING PLAN

Specific License No. SNM-2507, Docket No. 72-16
General License under 10 CFR 72.210, Docket No. 72-56

H1.0 UPDATED DECOMMISSIONING FUNDING PLAN - VIRGINIA ELECTRIC AND POWER COMPANY

Pursuant to 10 CFR 72.30(b), Virginia Electric and Power Company (Dominion) submitted its most recent decommissioning funding plan for the specifically- (License No. SNM-2507, Docket No. 72-16) and generally-licensed (Docket No. 72-56) North Anna Power Station Independent Spent Fuel Storage Installations (ISFSIs) on December 2, 2015 (Serial No. 15-122, ADAMS Accession No. ML15342A039).

10 CFR 72.30(c) requires each holder of a license under Part 72 to resubmit the decommissioning funding plan at the time of license renewal and at intervals not to exceed three (3) years with adjustments as necessary to account for changes in costs and the extent of contamination. In accordance with 10 CFR 72.30 (c), the information below provides Dominion's update to the North Anna ISFSI decommissioning funding plan at the time of license renewal.

<u>Information Required by 10 CFR 72.30(c)</u>

10 CFR 72.30 (c) requires the updated decommissioning funding plan to specifically consider the effect of the following events on decommissioning costs:

(1) Spills of radioactive material producing additional residual radioactivity in onsite subsurface material.

    There have been no reported spills at the ISFSI.

(2) Facility modifications

    There have been no facility modifications affecting the ISFSI decommissioning cost estimate (DCE).

(3) Changes in authorized possession limits.

    As stated below, the ISFSI DCE is based on ISFSIs that are sized, when used in conjunction with the spent fuel pool, to accommodate the spent fuel generated over the life of the station. There are no changes in authorized possession limits affecting the DCE.

(4) Actual remediation costs that exceed the previous cost estimate.

    No actual remediation costs have been incurred.

Pursuant to 10 CFR 72.30(b), a decommissioning funding plan must contain:

H1.1 Information on how reasonable assurance will be provided that funds will be available to decommission the ISFSI or Monitored Retrievable Storage (MRS)

Dominion provides financial assurance for the decommissioning of North Anna Power Station (NAPS), including the North Anna ISFSI, using the external sinking fund method. Its collections are based on site-specific cost estimates that include radiological decommissioning, spent fuel management (including ISFSI decommissioning) and site restoration.

Table H1.1-1 below shows the Total Funds and Allocated Radiological Funds accumulated as of December 31, 2015 and in future dollars for NAPS Units 1 and 2. The table shows that the funds available for ISFSI Decommissioning, Spent Fuel Management and Site Restoration exceed the ISFSI Decommissioning Cost Estimate amount.

Table H1.1-1 Total Funds and Allocated Radiological Funds (Dominion)

Unit End of License Year	Total Funds in External Trusts (12/31/15 $)	Total Funds in External Trusts (Future $) (1)	Allocated Radiological Funds in External Trusts (12/31/15 $)	Allocated Radiological Funds in External Trusts (Future $) (2)	NRC Minimum (Future $) (3)	Funds Available ISFSIs Decom, Spent Fuel Mgt & Site Restoration (12/31/15 $) (4)	ISFSIs DCE (12/31/15 $) (5)
North Anna Unit 1 2038	$438.50 million	$753.50 million	$301.38 million	$520.59 million	$440.02 million	$137.12 million	$1.42 million
North Anna Unit 2 2040	$411.90 million	$743.0 million	$285.23 million	$517.31 million	$440.02 million	$126.67 million	

<u>Notes to Table H1.1-1</u>

1. Total Funds in External Trust (Future $) = 2% Real Rate of Return applied to growth of funds in the External Trust to 3.5 years after Start of Decommissioning for each unit.
2. Allocated Radiological Funds in External Trust (Future $) = 2% Real Rate of Return applied to growth of funds in the External Trust to 3.5 years after Start of Decommissioning for each unit.
3. NRC Minimum (Future $) = NRC Minimum amount reflects December 31, 2015 NRC Minimum Amount due to the application of a 2% Real Rate of Return to growth of funds in the External Trust and keeping the NRC Minimum amount constant. The NAPS NRC Minimum Amounts are presented representing Dominion's 89.26% share of responsibility for NAPS decommissioning costs. North Anna Power Station is jointly owned by Virginia Electric and Power Company (88.4%) and Old Dominion Electric Cooperative (11.6%). However, Dominion is responsible for 89.26% of the decommissioning obligation.

4. Funds Available for ISFSI Decommissioning, Spent Fuel Management and Site Restoration (2015 $) is calculated as the difference between Total Funds in the External Trusts (2015 $) and the Allocated Radiological Funds in External Trusts (2015 $).

5. ISFSI DCE amount as reported in Table H1.2-1of this filing.

As a regulated electric utility, Dominion has the ability to recover its cost of service, including decommissioning funding, through rates. Dominion maintains a site DCE for NAPS, which it updates approximately every five years to determine whether there is any need to adjust rates collected from ratepayers and contributed to the external sinking fund.

H1.2 A detailed cost estimate for decommissioning, in an amount reflecting

The cost of an independent contractor to perform all decommissioning activities;

An adequate contingency factor; and

The cost of meeting the §20.1402 of this chapter criteria for unrestricted use, provided that, if the applicant or licensee can demonstrate its ability to meet the provisions of §20.1403 of this chapter, the cost estimate may be based on meeting the §20.1403 criteria.

General Methodology Used to Develop ISFSI Decommissioning Cost Estimates

An ISFSI DCE based on 10 CFR 72.30 requirements was prepared for the NAPS ISFSI in 2014. The ISFSI DCE was based on the assumption that a third party contractor would perform decommissioning. To determine the cost of using a third party contractor, fully burdened labor rates (labor costs plus employee benefits and taxes) were used as a basis and a premium was added to represent a third party contractor's profit margin.

The ISFSI DCE includes undistributed costs (for support activities and costs such as staff, security, insurance, energy, materials and services) allocated to the ISFSI decommissioning period. The ISFSI DCE includes 25% contingency in accordance with NUREG-1757, Volume 3, Revision 1. Table H1.2-1 below shows the contingency as one line item.

The ISFSI DCE is based on remediating the site to a residual radioactivity level consistent with 10 CFR 20.1402 (i.e., unrestricted use). As shown in Table H1.2-1 below, the estimated cost to Dominion to decommission the ISFSIs at NAPS is $1.396 million in 2014 dollars (89.26% decommissioning responsibility). Applying a CPI-based annual escalation rate to the 2014 dollars shown in Table H1.2-1, the total cost to decommission the NAPS ISFSIs is $1.424 million in 2016 dollars. The mnemonic for CPI-U is shown in Section H1.4.

Table H1.2-1 Cost Estimates Applicable to ISFSI Decommissioning Costs

North Anna Power Station Cost Estimates Applicable to ISFSI Decommissioning Costs - 10 CFR 72.30 (in thousands of dollars)							
ISFSI Decommissioning Activity Description	Labor	Equipment	Disposal	Other	25% Contingency	Total 2014 $	Total 2016 $
Distributed (Direct) Cost							
Preparation and NRC Review of License Termination Plan	$ 87	$ -	$ -	$ 137	$ -	$ 225	$ 229
Verification Survey of Horizontal Storage Modules	$ 117	$ 56	$ -	$ -	$ -	$ 173	$ 177
Preparation of Final Report on Decommissioning and NRC Review	$ 87	$ -	$ -	$ 137	$ -	$ 225	$ 229
Total Distributed (Direct) Cost	$ 292	$ 56	$ -	$ 275	$ -	$ 623	$ 635
Undistributed (Allocated) Cost							
Total Undistributed (Allocated) Cost	$ 323	$ 13	$ -	$ 157	$ -	$ 494	$ 503
Total North Anna ISFSI Decommissioning Cost	$ 615	$ 70	$ -	$ 432	$ -	$ 1,117	$ 1,139
25% Contingency Applied to Total North Anna ISFSI Decommissioning Cost Estimate					$ 279	$ 279	$ 285
Total North Anna ISFSI Decommissioning Cost Estimate with Contingency						$ 1,396	$ 1,424
Annual Escalation Rate (2014$ to 2016$)	0.99%	Escalation Rate based on average of CPI-U indices for period shown					
Decommissioning Cost Shown at	89.26%	Dominion Decommissioning Responsibility Percentage					

Differences due to rounding

H1.3 Identification of and justification for using the key assumptions contained in the DCE

The DCE for the NAPS ISFSIs assumes:

1. ISFSIs that are sized, when used in conjunction with the spent fuel pool, to accommodate the spent fuel generated over the life of the station.

2. Decommissioning will be performed by an independent contractor as required.

3. Storage canisters will be used to ship the contained spent fuel to the Department of Energy. Single purpose canisters will be qualified for shipment or transported in licensed transportation overpacks to avoid the need for repackaging and will maintain occupational exposures as low as reasonably achievable.

4. A dry transfer facility will not be necessary.

5. The ISFSI pads and support modules are assumed to be free of contamination and left in place.

H1.4 A description of the method of assuring funds for decommissioning from paragraph (e) of this section, including means for adjusting cost estimates and associated funding levels periodically over the life of the facility.

Dominion uses an external sinking fund method for NAPS. The external sinking fund is based on North Anna-specific cost estimates that include estimated ISFSI decommissioning costs. Dominion updates these cost estimates approximately every five years to determine whether there is any need to adjust rates collected from ratepayers and contributed to the external sinking fund. The ISFSI decommissioning funding plan periodically submitted pursuant to 10 CFR 72.30(c) will further adjust the most recent site-specific ISFSI DCE using a CPI indice-based escalation rate and will consider the need for any further adjustment based on the factors in 10 CFR 72.30(c)(1) - (4).

<u>The CPI indice annual escalation rate mnemonic is as follows:</u>

CPI - U: Urban Consumer - All Items, (Index 1982-84=100, SA), U.S. Bureau of Labor Statistics (BLS); Moody's Analytics (ECCA) Forecast, Quarterly, United States.

H1.5 The volume of onsite subsurface material containing residual radioactivity that will require remediation to meet the criteria for license termination.

Onsite subsurface material associated with the NAPS ISFSIs is assumed to have no residual radioactivity that will require remediation to meet the criteria for license termination. The spent fuel storage casks are sealed and contain no liquid.

H1.6 A certification that financial assurance for decommissioning has been provided in the amount of the cost estimate for decommissioning.

Dominion certifies that financial assurance for the estimated cost of decommissioning the NAPS ISFSIs has been provided as discussed above.

H2.0 UPDATED DECOMMISSIONING FUNDING PLAN - OLD DOMINION ELECTRIC COOPERATIVE

Pursuant to 10 CFR 72.30(b), Old Dominion Electric Cooperative (ODEC) submitted its most recent decommissioning funding plan for the specifically- (License No. SNM-2507, Docket No. 72-16) and generally-licensed (Docket No. 72-56) North Anna Power Station Independent Spent Fuel Storage Installations (ISFSIs) on December 15, 2015 (ADAMS Accession No. ML16020A001).

10 CFR 72.30(c) requires each holder of a license under Part 72 to resubmit the decommissioning funding plan at the time of license renewal and at intervals not to exceed three (3) years with adjustments as necessary to account for changes in costs and the extent of contamination. In accordance with 10 CFR 72.30 (c), the information below provides ODEC's update to the North Anna ISFSI decommissioning funding plan at the time of license renewal.

Pursuant to 10 CFR 72.30(b), a decommissioning funding plan must contain:

H2.1 Information on how reasonable assurance will be provided that funds will be available to decommission the ISFSI or MRS

ODEC provides financial assurance for the decommissioning of North Anna Power Station (NAPS), including the North Anna ISFSI, using the external sinking fund method. Its collections are based on site-specific cost estimates that include radiological decommissioning, spent fuel management (including ISFSI decommissioning) and site restoration.

Table H2.1-1 below shows the Total Funds and Allocated Radiological Funds accumulated as of December 31, 2015 and in future dollars for NAPS Units 1 and 2. The table shows that the funds available for ISFSI Decommissioning, Spent Fuel Management and Site Restoration exceed the ISFSI Decommissioning Cost Estimate amount.

Table H2.1-1 Total Funds and Allocated Radiological Funds (ODEC)

Unit End of License Year	Total Funds in External Trusts (12/31/15 $)	Total Funds in External Trusts (Future $) (1)	Allocated Radiological Funds in External Trusts (12/31/15 $)	Allocated Radiological Funds in External Trusts (Future $) (2)	NRC Minimum (Future $) (3)	Funds Available ISFSIs Decom, Spent Fuel Mgt & Site Restoration (12/31/15 $) (4)	ISFSIs DCE (12/31/15 $) (5)
North Anna Unit 1 2038	$71.88 million	$111.68 million	$49.59 million	$77.05 million	$52.94 million	$22.29 million	$0.17 million
North Anna Unit 2 2040	$73.84 million	$120.28 million	$50.94 million	$82.98 million	$52.94 million	$22.90 million	

Notes to Table H2.1-1

1. Total Funds in External Trust (Future $) = 2% Real Rate of Return applied to growth of funds in the External Trust to 3.5 years after Start of Decommissioning for each unit.
2. Allocated Radiological Funds in External Trust (Future $) = 2% Real Rate of Return applied to growth of funds in the External Trust to 3.5 years after Start of Decommissioning for each unit.
3. NRC Minimum (Future $) = NRC Minimum amount reflects December 31, 2015 NRC Minimum Amount due to the application of a 2% Real Rate of Return to growth of funds in the External Trust and keeping the NRC Minimum amount constant. The NAPS NRC Minimum Amounts are presented representing ODEC's 10.74% share of responsibility for NAPS decommissioning costs. North Anna Power Station is jointly owned by Virginia Electric and Power Company (88.4%) and Old Dominion Electric Cooperative (11.6%). However, ODEC is responsible for 10.74% of the decommissioning obligation.
4. Funds Available for ISFSI Decommissioning, Spent Fuel Management and Site Restoration (2015 $) is calculated as the difference between Total Funds in the External Trusts (2015 $) and the Allocated Radiological Funds in External Trusts (2015 $).
5. ISFSI DCE amount as reported in Table H2.2-1 of this filing.

As a regulated electric utility, ODEC has the ability to recover its cost of service, including decommissioning funding, through rates. ODEC obtains a site-specific DCE for NAPS from Dominion, which is updated approximately every five years, to determine whether there is any need to adjust wholesale power rates and contributions to the external sinking fund. The decommissioning cost is a fixed number in ODEC's formulary rate that requires Federal Energy Regulatory Commission approval prior to any adjustment.

H2.2 A detailed cost estimate for decommissioning, in an amount reflecting:

The cost of an independent contractor to perform all decommissioning activities;

An adequate contingency factor; and

The cost of meeting the §20.1402 of this chapter criteria for unrestricted use, provided that, if the applicant or licensee can demonstrate its ability to meet the provisions of §20.1403 of this chapter, the cost estimate may be based on meeting the §20.1403 criteria.

General Methodology Used to Develop ISFSI Decommissioning Cost Estimates

An ISFSI DCE based on 10 CFR 72.30 requirements was prepared for the NAPS ISFSI in 2014. The ISFSI DCE was based on the assumption that a third party contractor would perform decommissioning. To determine the cost of using a third party contractor, fully burdened labor rates (labor costs plus employee benefits and taxes) were used as a basis and a premium was added to represent a third party contractor's profit margin.

The ISFSI DCE includes undistributed costs (for support activities and costs such as staff, security, insurance, energy, materials and services) allocated to the ISFSI decommissioning period. The ISFSI DCE includes 25% contingency in accordance with NUREG-1757, Volume 3, Revision 1. Table H2.2-1 below shows the contingency as one line item.

The ISFSI DCE is based on remediating the site to a residual radioactivity level consistent with 10 CFR 20.1402 (i.e., unrestricted use). As shown in Table H2.2-1 below, the estimated cost to ODEC to decommission the ISFSIs at NAPS is $168 thousand in 2014 dollars (10.74% decommissioning responsibility). Applying a CPI-based annual escalation rate to the 2014 dollars shown in Table H2.2-1, the total cost to decommission the NAPS ISFSIs is $171 thousand in 2016 dollars. The mnemonic for CPI-U is shown in Section H2.4.

Table H2.2-1 Cost Estimates Applicable to ISFSI Decommissioning Costs

North Anna Power Station Cost Estimates Applicable to ISFSI Decommissioning Costs - 10 CFR 72.30 (in thousands of dollars)							
ISFSI Decommissioning Activity Description	Labor	Equipment	Disposal	Other	25% Contingency	Total 2014 $	Total 2016 $
Distributed (Direct) Cost							
Preparation and NRC Review of License Termination Plan	$ 10	$ -	$ -	$ 16	$ -	$ 27	$ 28
Verification Survey of Horizontal Storage Modules	$ 14	$ 7	$ -	$ -	$ -	$ 21	$ 21
Preparation of Final Report on Decommissioning and NRC Review	$ 10	$ -	$ -	$ 16	$ -	$ 27	$ 28
Total Distributed (Direct) Cost	$ 35	$ 7	$ -	$ 33	$ -	$ 75	$ 76
Undistributed (Allocated) Cost							
Total Undistributed (Allocated) Cost	$ 39	$ 2	$ -	$ 19	$ -	$ 59	$ 61
Total North Anna ISFSI Decommissioning Cost	$ 74	$ 8	$ -	$ 52	$ -	$ 134	$ 137
25% Contingency Applied to Total North Anna ISFSI Decommissioning Cost Estimate					$ 34	$ 34	$ 34
Total North Anna ISFSI Decommissioning Cost Estimate with Contingency						$ 168	$ 171
Annual Escalation Rate (2014$ to 2016$)	0.99%	Escalation Rate based on average of CPI-U indices for period shown					
Decommissioning Cost Shown at	10.74%	ODEC Decommissioning Responsibility Percentage					

Differences due to rounding

Information Required by 10 CFR 72.30(c)

See information provided by Dominion above.

H2.3 Identification of and justification for using the key assumptions contained in the DCE

See information provided by Dominion above.

H2.4 A description of the method of assuring funds for decommissioning from paragraph (e) of this section, including means for adjusting cost estimates and associated funding levels periodically over the life of the facility.

ODEC uses an external sinking fund method for NAPS. The external sinking fund is based on North Anna-specific cost estimates that include estimated ISFSI decommissioning costs. ODEC obtains these cost estimates from Dominion approximately every five years to determine whether there is any need to adjust wholesale power rates and contributions to the external sinking fund. The ISFSI decommissioning funding plan periodically submitted pursuant to 10 CFR 72.30 (c) will further adjust the most recent ISFSI DCE using a CPI indice-based escalation rate and will consider the need for any further adjustment based on the factors in 10 CFR 72.30(c)(1) - (4).

The CPI indice annual escalation rate mnemonic is as follows:

CPI - U: Urban Consumer - All Items, (Index 1982-84=100, SA), U.S. Bureau of Labor Statistics (BLS); Moody's Analytics (ECCA) Forecast, Quarterly, United States.

H2.5 The volume of onsite subsurface material containing residual radioactivity that will require remediation to meet the criteria for license termination.

Onsite subsurface material associated with the NAPS ISFSIs is assumed to have no residual radioactivity that will require remediation to meet the criteria for license termination. The spent fuel storage casks are sealed and contain no liquid.

H2.6 A certification that financial assurance for decommissioning has been provided in the amount of the cost estimate for decommissioning.

ODEC certifies that financial assurance for the estimated cost of decommissioning the NAPS ISFSIs has been provided as discussed above.